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ABSTRACT

Widely differing local conditions, increased community participation in education, more lifelong education, and decentralization of schools are factors which should affect the architecture of rural primary schools in Pakistan. Also significant are the results of a 1977 survey which indicate that building quality is unrelated to school attendance and that regardless of building availability most instruction occurs outside or in rustic sheds. These factors lead to a new basis of rural school building design which accomodates exterior spaces for school activities and reduces the use of inside closed space to storage or protection from inclement weather. A standardized one-room school building, modified for local climate, thermal conditions, building materials, and construction methods can provide adequate educational space for rural boys', girls', and coeducational schools. This lockable storage/office building, a shed structure, a boundary wall, and essential furnishings can be provided for approximately 1/8 the amount currently being expended for unused school buildings. The building should be sited so as to maximize available sunlight and prevailing winds. The detailed appendices use maps, charts, and architectural illustrations to present a climatic analysis of Pakistan, materials and structural requirements of different construction methods and designs, and architectural guidelines for various climates. (SB)

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DESIGN CONSIDERATIONS FOR CONSTRUCTION OF RURAL PRIMARY SCHOOLS

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DESIGN CONSIDERATIONS FOR CONSTRUCTION OF RURAL PRIMARY SCHOOLS

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GOVERNMENT OF PAKISTAN

ISLAMABAD

April, 1977

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This study represents an attempt to initiate new, more functional, more cost-effective designs for rural primary schools in Pakistan. Some preliminary observations were made, some architectural sketches reviewed, and the framework for this study was conceived.

Grateful acknowledgement is made to Wajid Ali Shah, Architect from Karachi, for the building sketch and alternative layout plans (Figures 1, 2, and 3) used herein.

The most substantial parts of this study, however, were made by the Design Team of "Schools for Pakistan". This group, under the sponsorship of the National College of Arts, Lahore, had compiled a comprehensive study on architectural elements of Pakistan schools. Because their study was out of print and so few copies were available, permission was obtained from the National College of Arts to use parts of their study as reference material, which is found in the Appendices herein. A roster of the members of the Design Team, together with the acknowledgements for their own study, is presented in Appendix F.

The authors wish to express their appreciation to the Government of Pakistan's Ministry of Education and to USAID for making this study possible.

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I. PAKISTAN AND ITS COMPOSITE AREAS

The country of Pakistan, which is contiguous with and topographically similar to parts of Iran, Afghanistan, China, and India, faces many of the same constraints to school building. These include the need to design to resist the effects of earthquakes, the problems of building for scattered communities in arid areas of desert and hills, the difficulties of providing facilities in mountainous areas where people live at elevations in the region of 3,000 metres and more, and, in many places, a very limited variety of materials suitable for building. There are, of course, lush plain areas such as the Punjab, but they are by no means characteristic of the country as a whole.

Pakistan, somewhat like Australia and India, is divided for purposes of education into Provinces and other areas, some of which are Federally administered. Educational policy is determined by the Federal Government and in the Provinces, implemented by the Provincial Ministers of Education through the Provincial Education Departments.

Differences in climate and local materials have led, over the years, to the development of a local school architecture in the various provinces. In the hilly regions of the Northwest Frontier Province, for example, buildings are of stone, while in the Punjab they are usually of brick. For the purpose of this study the country has been divided into the following areas; a map of the climatic zones is presented in Appendix A.

a) SIND
   i) Coastal Belt
   ii) Upper Sind (Low Lands)
   iii) Lower Punjab

b) BALUCHISTAN
   i) South and
   ii) Western Area of Pak.

c) PUNJAB
   i) Punjab
   ii) Upper Sind (Agricultural Areas)

d) N.W.F.P.
   i) Himalayan Regions

Herein provided is a basic summary of the physical and socio-economic conditions of the typical rural communities of various regions of Pakistan.

This study tries to show how the climate, topography, culture and economic conditions affect the living pattern, the construction techniques and the physical growth of the villages.

This report of the various regions of Pakistan attempts to point out the typical contrast in the living patterns and the constructional patterns occurring because of changes in climates, topography, economic and social conditions.

The survey work in connection with this study has shown that a great deal of overlapping takes place climatically among the designated areas, for each area some data and information have been compiled on:

(a) Existing spatial needs
(b) Existing socio-economic conditions
(c) Communication and transportation

A study and survey has also been made of:

(a) Spatial needs
(b) Material needs
(c) Psychological needs
(d) Sociological needs
(e) Climate, etc.
(f) Physical Resources
(g) Intellectual Resources

Thus, to a very limited extent, investigations have been made topographically, socially and economically in the four provinces of Pakistan. Summaries of the four provinces are provided in the remainder of this chapter.

1. SIND COASTAL BELT

The Sind Coastal Belt of Pakistan borders along the Arabian Sea. See Appendix A for the climatic map and for the specific districts within the Sind.

Topography

Except for the Delta region of the River Indus and the Run of Kutch, which is marshland, the rest of the coastline is rugged. As one goes inland the

Mekran coast ranges start which are composed mainly of limestone and are broken in places by nallahs and rivers.

Vegetation

The scarcity of water and the sandy soil allow the growth of only dry bushes, shrubs, and palm trees.

Villages

Two types mainly predominate; agricultural and fishermen's.

(a) AGRICULTURAL VILLAGES: These villages are usually found on flat-lands along natural waterways and on the side of rivers.

The joint family system which predominates this area results in large individual households. Each household consists of a number of houses each belonging to a family unit and are built around a central open space which contains kitchens of each family unit and this open sapce usually has one access. One village consists of 4-5 households about a furlong away from each other in an orbit of one furlong from the village center, consisting of a mosque and one or two general provision shops.

(b) FISHERMEN'S VILLAGES: These are situated at an average distance of about 200 ft. from the seashore. They are found along the sea coast at different intervals, depending upon the land formations along the seashore. Fishing is the only occupation and income source and the standard of living is generally higher than the agricultural villages. This way of life has a strong influence on the building form and methods of construction.

Climate

This region is well outside the monsoon belt and bordered by the arid zones of Sind and Baluchistan. It has scanty rainfall around July and August. (See appropriate maps in Appendix B.)

Materials and Methods of Construction

Non-availability of any sort of local building material results in no standard material and methods of construction being generally found (see Appendix

D for illustrations):

(i) Concrete block construction is found in villages situated near urban center. Sand locally available cement are from a nearby urban center.

(ii) Wooden construction where boat building is done. Usually found very near the seashore. Wooden planks irregularly placed with a wooden trussed roof is the main method of construction.

(iii) Villages situated where the soil contains some clay, have rural construction units of clay. For detailed types of construction and their frequency by district, please refer to the maps and tables presented in Appendix C.

2. UPPER SIND AND LOWER PUNJAB (Low Land)

Topography - Lower and upper Indus plains rich with silt from the mighty Indus River. (See maps in Appendix B.)

Climate - (Please refer to the maps shown in Appendix A and B.)

- Summer usually dry (desert climate).
- Month of May and June temp. 120°F.
- Dust storms frequent in the dry periods.
- Winter extreme cold nights below freezing point temperature.

Material and Methods of Construction (for details, see maps and tables in Appendix C).

- Clay bricks, katcha sun dried, baked.
- Clay plaster on both sides.
- Dates and other tree trunks for spanning roofs.
- Clay walls reinforced by tree branches and covered with clay or cement plaster.
- Mud and lintel system.

- Flat roof construction (wooden beam).
- Small or no opening to prevent the interior of the houses from the radiation during the hot dry period. Nights are cool, therefore, courtyard or roof is used for sleeping.
- Roof is usually of thatch.
- Thick wall of clay in the form of baked block insulate from heat.
- Courtyard is the main and important part of the house where majority of the activities take place; while the rooms are used for storage, sleeping during the day time in dry hot period, and for living in the extreme cold period.

3. BALUCHISTAN

Southwestern part of Pakistan (see map in Appendix B).

Climate (For details see maps and tables in Appendices A and B).

Area of low humidity, low rainfall and is barren. During summer, high temperatures prevail in the day time and low temperatures at night. In winter, snow falls on the higher elevations and cold dry days prevail. The population is sparse and widely distributed because of scarcity of water. In the mountainous area the land is comparatively more fertile and so vegetation is more abundant. On the desert low lands, vegetation is restricted to scattered shrubs and occasional trees.

Materials and Construction (for details, see Appendix C).

In the mountainous area, stone is extensively used while on the lowlands, houses having very thick walls made out of sun-dried mud bricks are built. On the lowlands flat-roofed wooden houses are built with wooden beams while in the mountainous region wooden sloping roofs are found.

4. PUNJAB

Topography (See Appendix B for maps.)

Mainly flat, fertile land. Five main rivers flow across it. Soil is loamy and clayee, very suitable for agriculture.

Climate (For detailed analysis, see Appendices A & B).

Composite climate - hot, dry season (April-June) weather dusty with occasional sandstorms. Hot monsoon (July-Sept.), very humid with high temperatures. Cold, winter season (October-March), with low temperatures falling below zero degrees centigrade in the northern region.

Villages Growth Pattern

Villages tend to be small and numerous and closely arranged. Houses are located around sources of domestic water supply; e.g., well. A chain of small pedestrian streets connect different parts of the village.

Methods of Construction (For details, see the maps and tables in Appendix C).

Clay soil found there is excellent for construction. Sun-dried mud bricks or irregular blocks are used in constructing walls, being plastered over with a mixture of mud and stone. Wooden logs are used as beams and these are overlaid with wooden planks in roofs with a layer of mud and straw plaster being used as a sealant (see Appendix D).

Wooden windows are framed in wall cutouts with single story construction, due to nature of materials and primitive methods of construction used. House building is done by men and women together. Maintenance and upkeep duties are done by women.

5. N.W.F.P.

Himalayan and Hindu Kush Ranges constitute the bulk of this area.

Topography (See Appendix B for details).

Contour levels vary from 8500 to 15,000 feet above sea level. The area is very mountainous. Lowest parts are in the form of valleys and river beds around which the population exists. Soil is basically dry, consisting of high

content of calcium carbonate and low content of organic matter. Water is plentiful in the form of melted snow glaciers, springs and plentiful subterranean water deposits.

Vegetation

Clearly demarcated zones of vegetation are found according to elevation and rainfall. Mostly trees are evergreen and softwood.

Climate (For details, see Appendices A and B).

There is high rainfall mainly due to precipitation which occurs on the windward side of the ranges.

Materials and Methods of Construction (See Appendices C and D for frequency of construction and illustrations).

Stone from the mountainside and wood from the forests are the main materials. Foundations of stone are raised and externally covered with mud plaster used also on interior floors and occasionally on walls. Wooden beams and columns are gradually covered with climber abundantly found which accentuates the organic form of construction. Artisans also show their skills in decorative wood work which is a symbol of this area.

II. CONSIDERATIONS IN THE CONSTRUCTION OF RURAL PRIMARY SCHOOLS.

It is a continuing challenge to those constructing rural primary schools to accommodate the tendencies for change and their implication in educational architecture.

The past, present, and the future modern educational thinkers or planners are increasingly using a certain type of vocabulary when discussing education of the future; the words being - change, innovation, self-generation of money, reforms, etc., etc. But all these words are just slogans, because in Pakistan the problems are many and like in all developing countries, they are magnified by the difficulties of coping with systems imported from old colonial or economic powers and super-imposed on the Third World cultures.

The problems—real and supposed—are many. Respect of authority and apparent order has become more important than the transfer of knowledge. Arbitrary goals are set on paper which are never achieved.

Before considering some of the most important tendencies for change and their implications for educational architecture, it is important to note some of the major factors which have come to light during the field survey work and which have a direct effect on the school buildings.

During the survey certain constraints were identified highlighting major problems, which likewise helped understand realistically the possibilities and potentialities for change.

1) Initial Cost - Having to spend money on such noneducational items as buildings, creates budgetary constraints which restrict the building's role to that of providing shelter without amenity; spaces without regard for the process going on within.

2) Shortage of Professionals - With a shortage of professional archi-

tects, buildings cannot be given proper professional attention and result in costly unique plans or in the misuse of standard plans (if any!).

3) Standardization of Buildings - Standardization yields savings in an industrialized economy; the converse is often true in a developing country. National standardization of school buildings often means losing the advantage of particular local conditions which could effect considerable construction savings.

4) Official Class Size - It has been observed that buildings are planned with "standard" areas per class and per child which are based on very carefully worked out studies of the exact minimum areas occupied by students and teachers.

What seems to have been overlooked are that (a) the actual size of classes rarely matches the official size; (b) the number of students available for each grade is practically never the same; (c) the minister can change the official class size with the stroke of a pen.

5) Thermal Factors - The factors of sun and wind often determine the final shape and orientation of the buildings overriding the advice of the educator.

6) Designs of Buildings - Building designs have been mostly prepared by the Public Works Department based on age old specifications and building codes, rather than by a penetrating analysis of actual conditions. The usual result is inappropriate and uncomfortable buildings.

Keeping in mind the above points, it is important to recognize and analyze important tendencies in the educational system which are likely to have the strongest influence on architecture. Some of these are discussed in the succeeding chapter.

III. SCHOOL-COMMUNITY CONSIDERATIONS AND THEIR ARCHITECTURAL CONSEQUENCES.

Among the concepts to be weighed in rural primary schools construction are community participation, life-long education, and decentralization. These, together with their architectural implications, are now discussed.

1. Community Participation

Officials who fail to seek advice from the community when planning new school places or the closure of schools, not only risk public disfavor, but also forfeit the benefits of citizen participation in the schools. Community representation in the school facilities planning process helps to promote good public relations, establish effective communication between school and community, and develop ideas for a school that can reflect community values and promote community involvement.

Education should be related to daily life. Educational programs should be built around the realities of individual communities. Education in rural areas should train people for increasing crop production, development of handicrafts or improvement of community health facilities.

Thus one at once foresees the traditional narrowly concerned colonial primary school being replaced gradually by a local community center with a broad role.

The architectural form of such centers will be as radical a change from existing primary schools as will be the content.

The buildings, rather than being constructed of imported materials, should be made of local materials. With experimental modifications these could gain acceptance and improve local building techniques. The community center could in itself be a full-scale learning area involving local people in its planning and construction. Such a place would be an educational market place. Education

at the same time could also include the operation of experimental farm plots and possibly a small local craft industry; e.g., schools in Ceylon (furniture manufacturing, etc.).

2. Life-Long Education

Coming back again to the importance of community participation, it is argued that if education is no longer to be a privilege afforded to the young and anyone is to have a right to continue his education whenever he pleases (adult education), a vast expansion in facilities will be necessary. How can the government, struggling with the high cost of providing education to only a small part of the school-age population, afford to expand its educational system?

The answer lies in local participation and hence utilization for educational purposes of spaces that normally are used for other things or are not used at all.

Educational spaces should serve a wide range of functions. They must be an integral part of the community and virtually indistinguishable from the surrounding structures. They must be easily accessible both as to place and time and must be located to serve community functions; e.g., sports, films, and should also cater to the needs of farmers, workers, and housewives as well as those of the children at large.

3. Decentralization

As a result of village educational centers, education will be decentralized. Communities can then have an architecture which will be more humane than the ones which institutionally-minded administrators are all too eager to accept from architects who are anxious to create viable, monumental, photogenic buildings.

Educational spaces in the new order should be able to reflect social needs and invite the entire community to enter them. In order to reflect change in community life, buildings should have a much more temporary quality than today's

concrete and steel educational fortresses designed to defend the existing educational system.

Movable space is one answer to this problem. Another is dual purpose space which might be used for commercial, social or educational purposes, depending on the needs of any given generation.

4. Architectural Consequences

Community centered educational centers cannot be designed as an assemblage of classrooms as such. Centers should be created in such a manner that they educate. The center may be carved out of a large centrally available space, the inside of which can be altered, changed and revised to serve education. Large interior, open spaces, with small groups working on a variety of subjects in different corners will replace rigid classrooms with children neatly lined up in rows.

Apart from some of the educational changes which may seem difficult to achieve at present, many are not such radical departures. They resemble present systems that architects and educational administrators can now accept and require only small changes. In fact nothing should prevent architects from designing schools that welcome children and adults alike.

To build educational centers of local materials in tune with the local enviornment is probably both less expensive and easier to achieve than the pseudo-sophisticated schools frequently encountered.

IV. A BASIS FOR NEW BUILDING DESIGNS FOR RURAL PRIMARY SCHOOLS.

A. SURVEY OBSERVATIONS.

In a 1976 nationwide survey of more than 800 rural primary schools, a building score was obtained for each school. This score was standardized to reflect the quality of the building in such aspects as structure, maintenance, adequacy of site, location, equipment, amenities, etc.

One of the most startling findings from the survey was that the quality of the rural school buildings in Pakistan had no significant relationship to pupil attendance. This lack of relationship was answered as the BEPM staff verified the building scores and attendance with some checks on the tabulation made on-site. The challenge, however, remained and observations were constantly made to try to refute, verify, or gain some understanding about this lack of relationship. Some of the following observations seem relevant:

It was consistently noted in the on-site visits that, aside from some of the Sind schools which had ample furniture, the teachers and youngsters were always outside the buildings. It did not seem to matter whether it was a new school building or an old one, the seating pattern outside was always the same. The principal use of the buildings seemed to be storage and a place for safekeeping of papers and materials. Inquiries with teachers and administrators confirmed that the observations were accurate. It appears that most school buildings are used as shelter from rain, or in times of extreme heart, they provide an escape from the direct sunlight. Usually, however, students and teacher in the latter case prefer a nearby tree if a suitable one is available. Guided observations of the school buildings—even the newer ones—reveal that there is no artificial illumination, no way to regulate the temperature, and few characteristics that are inviting or conducive to learning. Obviously, there is need for some indepth studies of building utilization.

Another observation relates to the kinds of structures erected to serve the pressing building needs of a village school. Aside from the storage place provided by a solid building and the boundary wall that appears to be essential in many villages, particularly for girls schools, the shelters erected for use are what can perhaps best be described as sheds. These are made of pole or stone/brick uprights with some kind of roof, usually thatching with poles or sticks. In most observations made thus far, these structures have been consistently utilized even when some rather impressive solid buildings on the same compound were not being used.

Pakistan's villages are changing—slowly in some cases, but nevertheless changing in attitudes, institutions, and other ways related to education. Perhaps there is a need to rethink the need for the costly investment of two solid, long-lasting schools in nearly all villages. As more change comes, it is quite likely that the need may be for only one school with mixed enrollments as there appears to be in many villages even now.

The lack of a significant relationship between the quality of school buildings and pupil attendance becomes understandable as one sees how and how often such buildings are not used in existing schools.

B. CONCEPTS TO SHAPE NEW BUILDING DESIGNS.

Classrooms of the present rural schools on the one hand appear as closed, overcrowded cells, removed from the world, and also under-equipped. It is a cramped envelope, empty in content. In the extreme cases one is even faced with a reversal of qualities. That is, there appears to be an overemphasis on the conventional external envelope components and a scarcity, if not complete lack, of internal equipment elements. External school spaces are huge, but empty.

The above characteristics can be reversed advantageously by the following:

1. By accommodating the external spaces for school activities.
2. By reducing the use of inside closed spaces to very simple functions, such as shelter against weather, inclemency, and storage.

1) External Spaces.

As observed during the field survey work of the actual school year and the running of the school activities in the largest part of the country, it is felt only necessary to provide protection against sunshine and some rain and to maintain good natural ventilation, with adequate natural lighting conditions. Showers, as well as other meteorological phenomena such as wind and sandstorms, etc., are generally foreseeable, and of short duration.

If we accept this proposition, it is sufficient to provide temporary shelters for the pupils and protective means for the teaching materials.

Thus continuing the development of external spaces, this suggests a minimum accommodation allowing an extensive use of local techniques and resources. Some of these possibilities include:

(a) roofing with mats, straw, etc. (locally produced)

(b) light framework of timber

(c) external enclosure boundary walls (locally produced)

(d) compacted flooring (local stone, lean concrete slab, etc.).

The recovery of external spaces is only meaningful if the recovered area is used and animated by stimulating instructional equipment. This equipment can be considered the main investment effort.

2) Interval Space.

It follows that internal closed space will be only used as temporary shelter against weather inclemencies or as such will be easy to implement with local techniques.

V. RECOMMENDED BUILDING DESIGNS FOR BOYS, GIRLS, AND COEDUCATIONAL SCHOOLS.

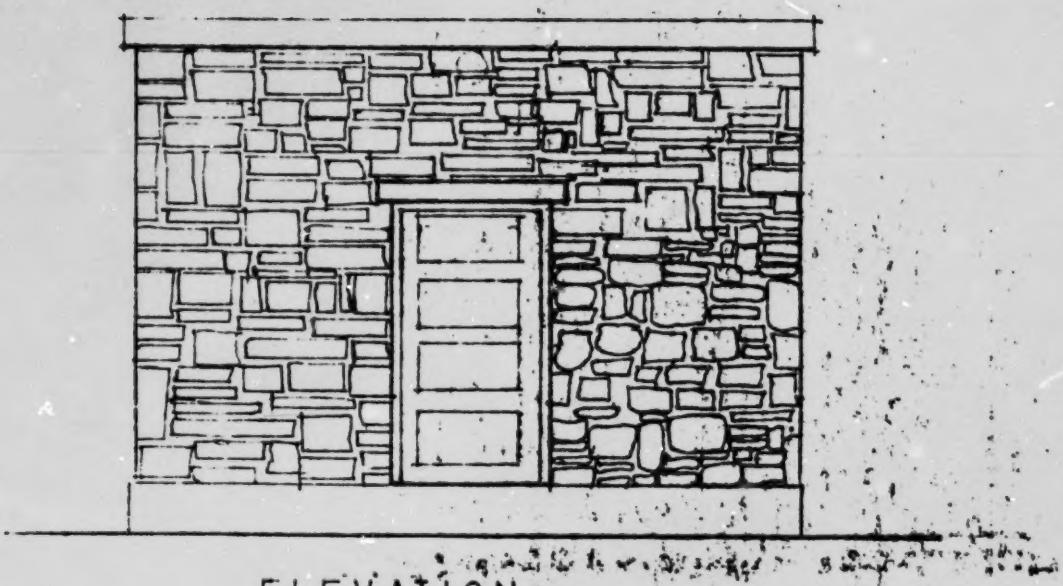
As cited in the previous chapter the need for school building utilization studies is obvious. Based on HEPM's on-site surveys and data, however, there appears to be a readiness for a better design for school buildings. A tentative surmise would be for some kind of inexpensive combination of a storage-office room that locks and one or more shed-like structures that provide shelter from the severest weather conditions that exist in the seasons when schools are open. An off-hand estimate is that such facilities could be put in place together with boundary wall and essential furnishings for an amount ranging from RS.5000 to RS.10,000 maximum. This is considerably less investment than the Rs.65,000 to Rs.80,000 currently required to construct a nonfunctional two classroom building such as is now standard practice.

Recommended School Room Specifications

The design for one room to be used primarily for storage and office use is presented in Figure 1. While the construction shown in Figure 1 is of stone walls and mud, a wide variety of types of construction on the same dimensions is presented in Figure 1; Appendix D illustrates the many types of construction with various materials and workmanship that will fit the appropriate climatic area. Appendix C provides the mode for the type of construction by district.

Siting the One-Room Building

The physical environment provides a series of major considerations in locating the building on the selected site. The first consideration is directional; that is, locating the building in such a way as to capitalize on the direction of the prevailing winds and to maximize the effect desired from the sunlight. The climatic condition will dictate the sunlight consideration and series of charts showing prevailing winds at different times of the day for each month is presented in Appendix B to provide guidance in the decisions related to



ELEVATION

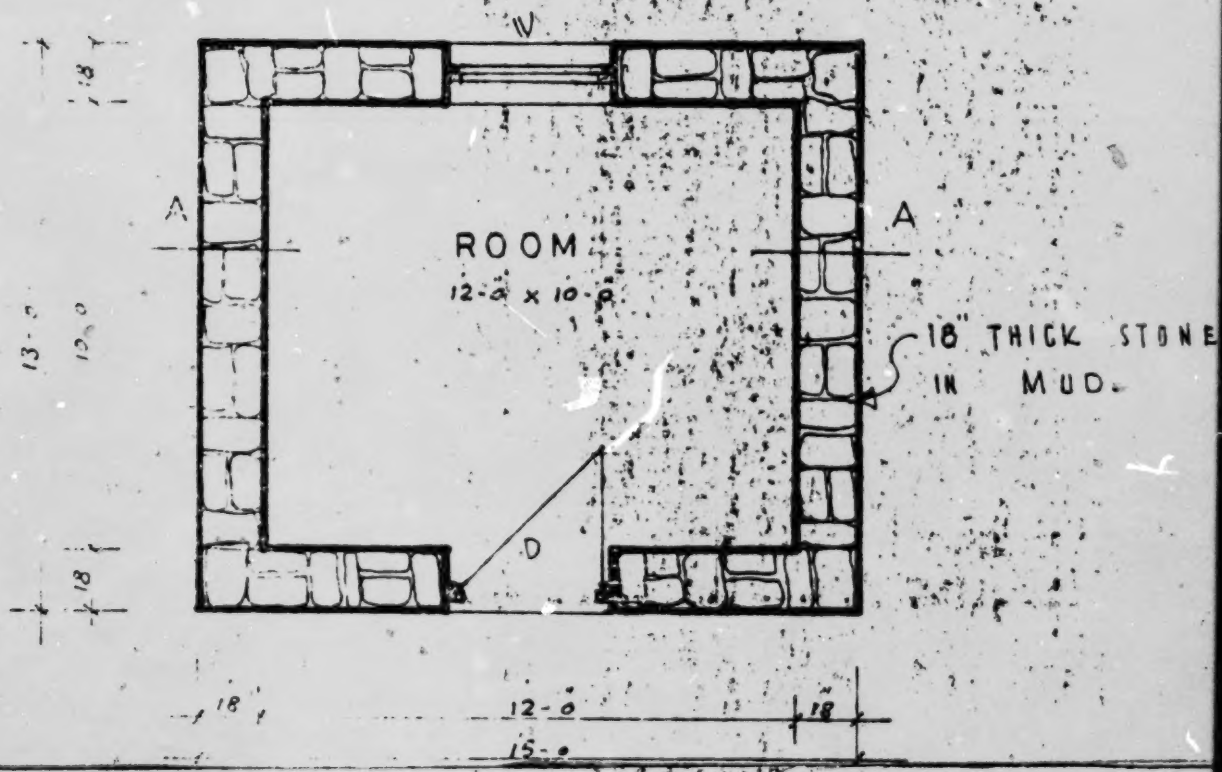
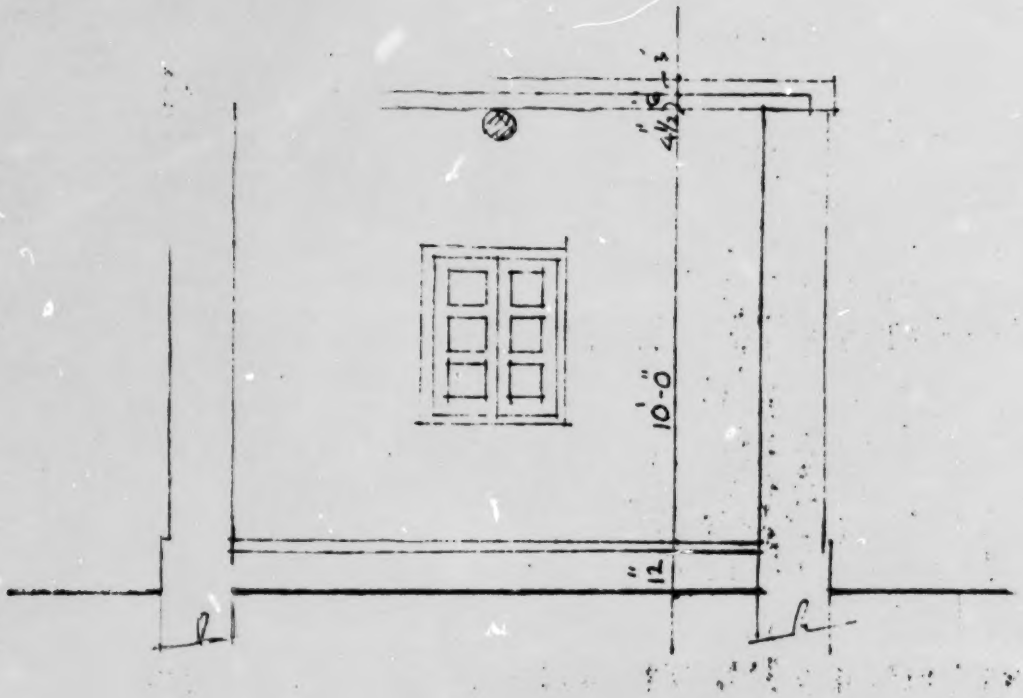


Figure 1. DESIGN OF ONE ROOM SCHO
OF STONE WALLS IN MUD.
SCALE:- 1" = 4-0"



SECTION ON A A

SCHEDULE OF	
TYPE	D E S
D.	DOOR P SINGLE
W	WINDOW DOUBLE

HOOL Figure 1.(cont)

best utilizing the prevailing winds. See also the summary chart in Appendix E for guidelines on window orientations, air movement and topography. Thus in site selection to obtain maximum efficiency with regard to climatic factors which effect in the orientation of a building, consideration should be given to:

TOPOGRAPHY:

- Land form
- Bodies of water
- Vegetation:
  - Trees (above or at body level)
  - Hedges
  - Grass

SOLAR ORIENTATION

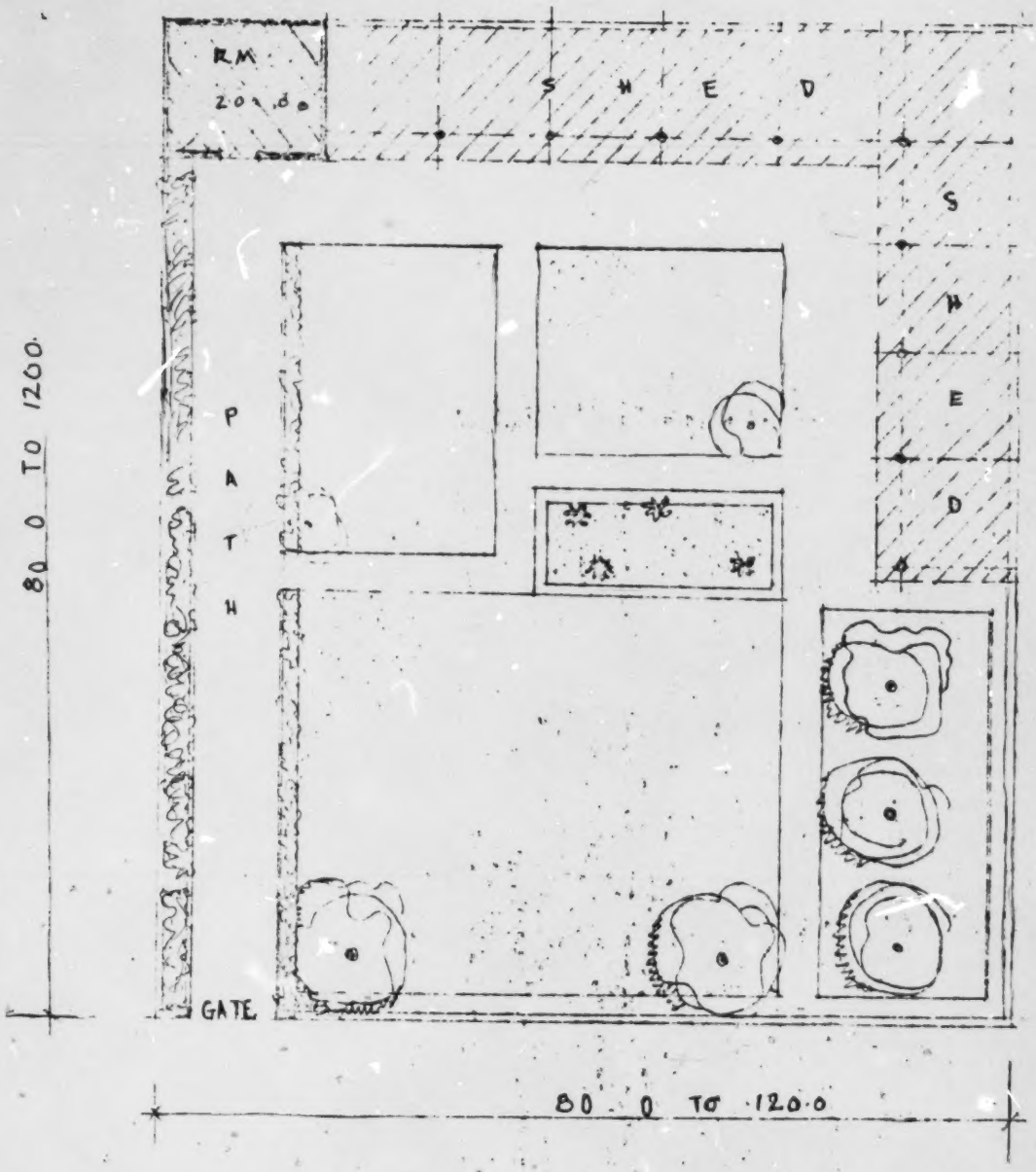
AIR MOVEMENT.

Location on the Site Lay-Out Plan:

Another major series of considerations in building location on a site is maximizing the educational possibilities of building and site. This entails planning for a school boundary wall, particularly in the case of girls, and for such educational areas as those used for school farm or garden, playing fields or recreation areas, shade trees, sheds for protection against sunshine or inclement weather, etc. While there are many alternative lay-out plans for siting a building, two suggested plans for illustrative purposes are presented in Figures 2 and 3. Both lay-out plans show provision for a boundary wall to make them acceptable for girls schools or coeducation or boys schools.

Modification of the Building and Site Because of Climatic Conditions:

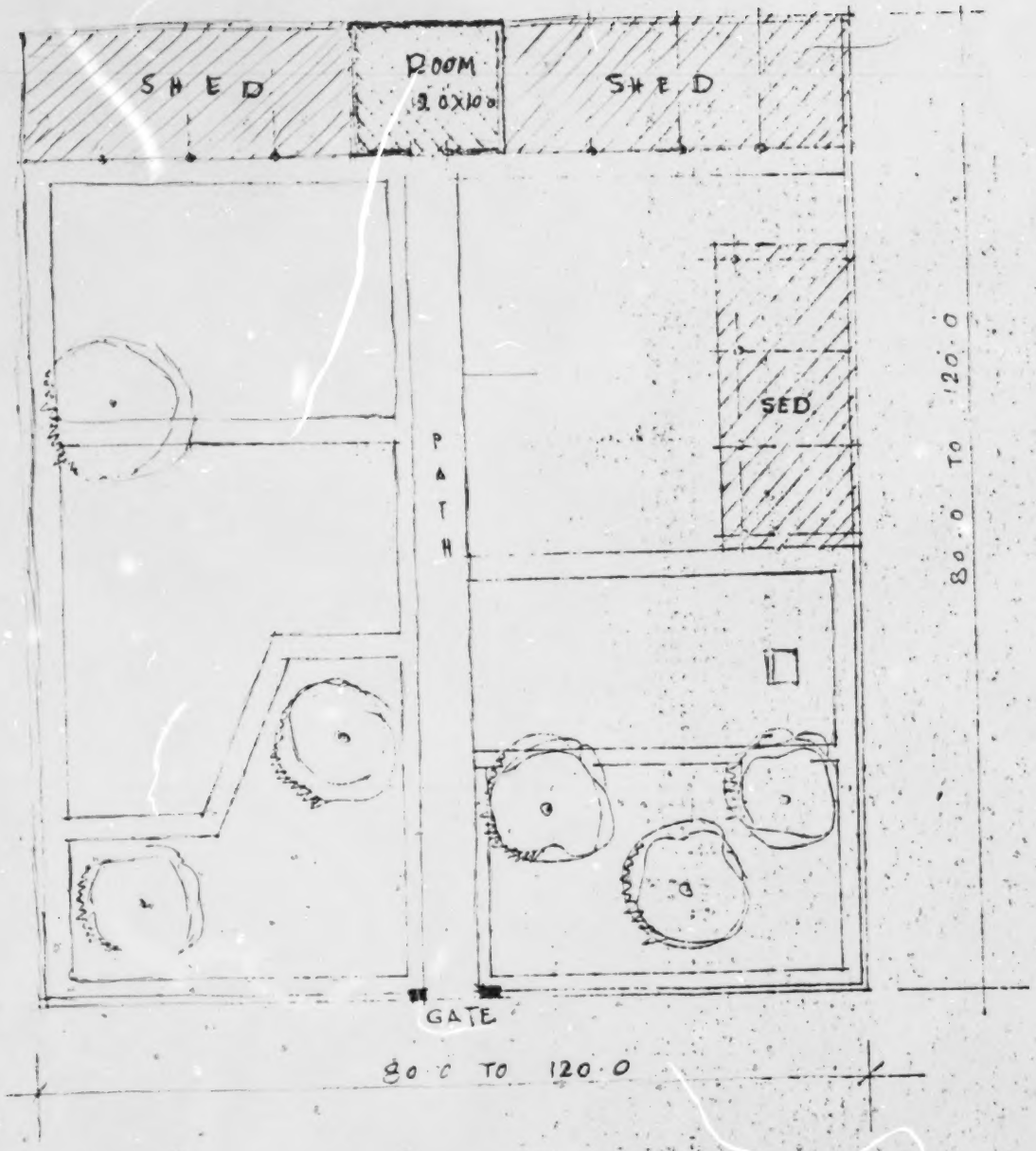
A number of architectural modifications can be made to the prototype building specifications given in Figure 1, depending on the predominating season. In some instances, it may require the construction of two rooms, such as in the warm and normal composite seasonal setting. Table 1 presents the dominating seasons in each climatic area that requires special architectural treatment. Appendix E provides the details of this special treatment for each season. The



LAY-OUT PLAN "A"

Figure 2.

ALTERNATIVE LAY OUT PLAN
ONE ROOM SCHOOL.



LAYOUT PLAN. "B"

Figure 3.

ALTERNATIVE LAY OUT PLAN
ONE ROOM SCHOOL

specific modifications are outlined as they effect (a) radiation control; (b) air temperatures; (c) air movement; (d) humidity; (e) storms; and (f) precipitation. In addition to these modifications and an analysis, Appendix E also provides a comparative summary table for all seasons.

Table 1. DOMINATING SEASONS IN EACH CLIMATIC TYPE REQUIRING ARCHITECTURAL TREATMENT.

SEASONS	HOT DRY	HOT HUMID	COLD	MONSOON
Maritime		X		
Inland Maritime	X	X		
Extra Dry Cool			X	
Extra Dry Hot	X			
Warm Composite	X	X		X
Normal Composite	X	X	X	X
Cool Composite			X	X
Cold Composite			X	X

NOTE: "X" denotes dominating season.

APPENDIX A

CLIMATIC ZONES OF PAKISTAN

CLIMATIC ZONES

Two elements of the climatic data, the mean dry bulb temperature and the relative humidity (for 0500 hours and 1700 hours) are plotted on the Bioclimatic chart, to give us the comfort conditions prevailing in that particular region.

Similar comfort conditions are grouped together to form similar climatic conditions. These results were superimposed on the topographical maps thus determining the climatic zones.

The climatic zone map is then superimposed on the administrative divisional map to give us the districts falling within each climatic type.

The climatic types evolved are as follows:

I. Cold Composite

II. Cool Composite

III. Cool Extra Dry

IV(a). Normal Composite

IV(b). Warm Composite

V. Hot Extra Dry

VI. Inland Maritime

VII. Maritime.

Page A-1 blank.

CLIMATIC
composite
composite
composite
dry cool
extra dry hot
inland maritime
maritime

CLIMATIC DIVISIONS ACCORDING TO DISTRICTS

PROVINCE	SIND	PUNJAB	BALUCHISTAN	N.W.F.P.
Cold Composite				Chitral Dir Swat Kalam Hazara
COOL Composite				Dir, Swat, N&S Waziristan, Khybe Kohat, Hazar Khurram, Mohmand
Normal Composite		D.G.Khan Muzaffargarh Multan, Sahiwal Bahawalnagar, Lyallpur, Jhang Mianwali, Sargodha, Lahore Sheikhupura, Gujranwala, Sialkot, Jhelum Gujrat, Campbel-pur, Rawalpindi.		N&S Waziristan, Bannu, D.I.Khan, Kohat, Peshawar, Mardan, Malakand Hazara, Swat.
Warm Composite	Jacobabad Sukkar, Larkana, Khair-pur, Nawabshah Sanghar, Dadu	D.G.Khan, RY.K. ar Bahawalpur, Bahawalnagar, Multan Muzaffargarh	Kachi Sibi	
Inland Maritime	Dadu Nawabshah, Hyderabad, Tharparkar Sanghar Thatta		Makran Kalat Lesbela	
Maritime	Karachi Thatta		Makran Lesbela	
Extra Dry Hot			Chaghai Kharan	
Extra Dry Cool			Kharan Sibi Kalat Loralai Quetta Zhob	

A P P E N D I X B

A CLIMATIC ANALYSIS OF PAKISTAN

A GUIDE TO PRIMARY SCHOOL BUILDING CONSTRUCTION

INTRODUCTION

OBJECTIVES

To analyze the climate of Pakistan so as to define climatic needs against climate conditions and the way in which these should influence the building form and the resultant comfort conditions. To obtain this the following data was collected:

(A) The prevailing climatic data was acquired from the meteorological stations at Lahore and Karachi. This data applied to 44 stations and were established for an average of 30 years (1931-1961). The information received covered the following elements of climate:

(i) Mean max dry bulb temperatures in degrees F.

(ii) Mean min dry bulb temperatures in degrees F.

(iii) Relative humidity in percentage.

These readings were obtained for 0500 hours and 1700 hours.

(iv) Air movement:

(a) Wind speed readings in knots/hour converted into feet/minute. These readings were recorded for 0500 hours and 1700 hours.

(b) Wind direction: Average monthly readings recorded at 0800 hours and 1700 hours.

(v) Precipitation: Readings in inches and also recording number of rainy days per month.

(vi) Diurnal Range: Readings in degrees F.

NOTE: All readings were recorded monthly.

(B) Topographical data for Pakistan:

(i) Land form
(ii) Bodies of water
(iii) Vegetation

This information was obtained from the following sources:

(a) Survey of Pakistan: Maps

(b) Soil Survey of Pakistan: Maps

(c) Oxford School Atlas for Pakistan

(d) District Census Reports: Maps.

(C) Divisions:

(i) Administrative divisions

(ii) Geographical divisions.

This information was obtained from the Survey of Pakistan Maps.

POLITICAL DIVISIONS

B-3

METEOROLOGICAL STATIONS

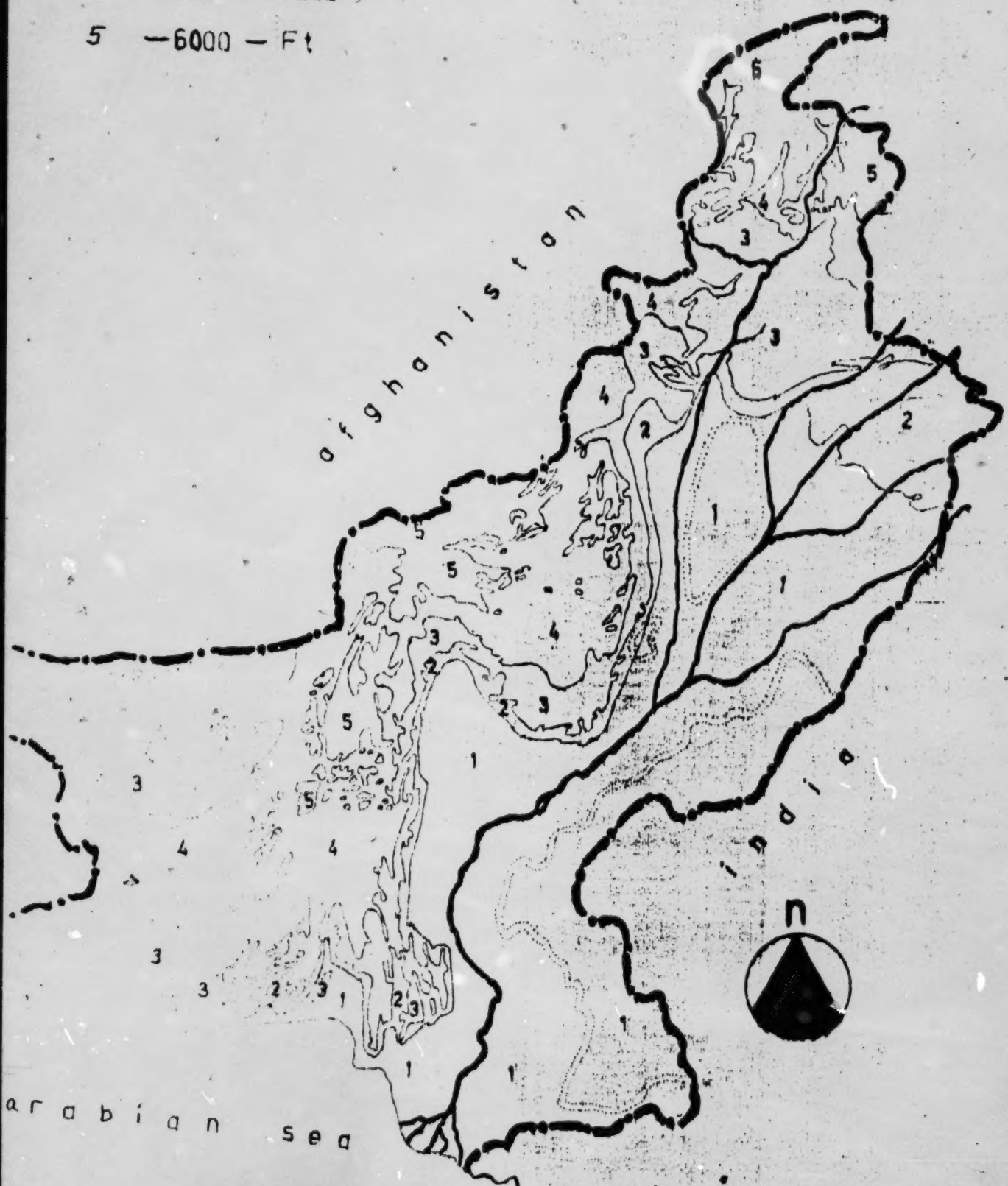
LAND FORM

2 600 – 1000 Ft

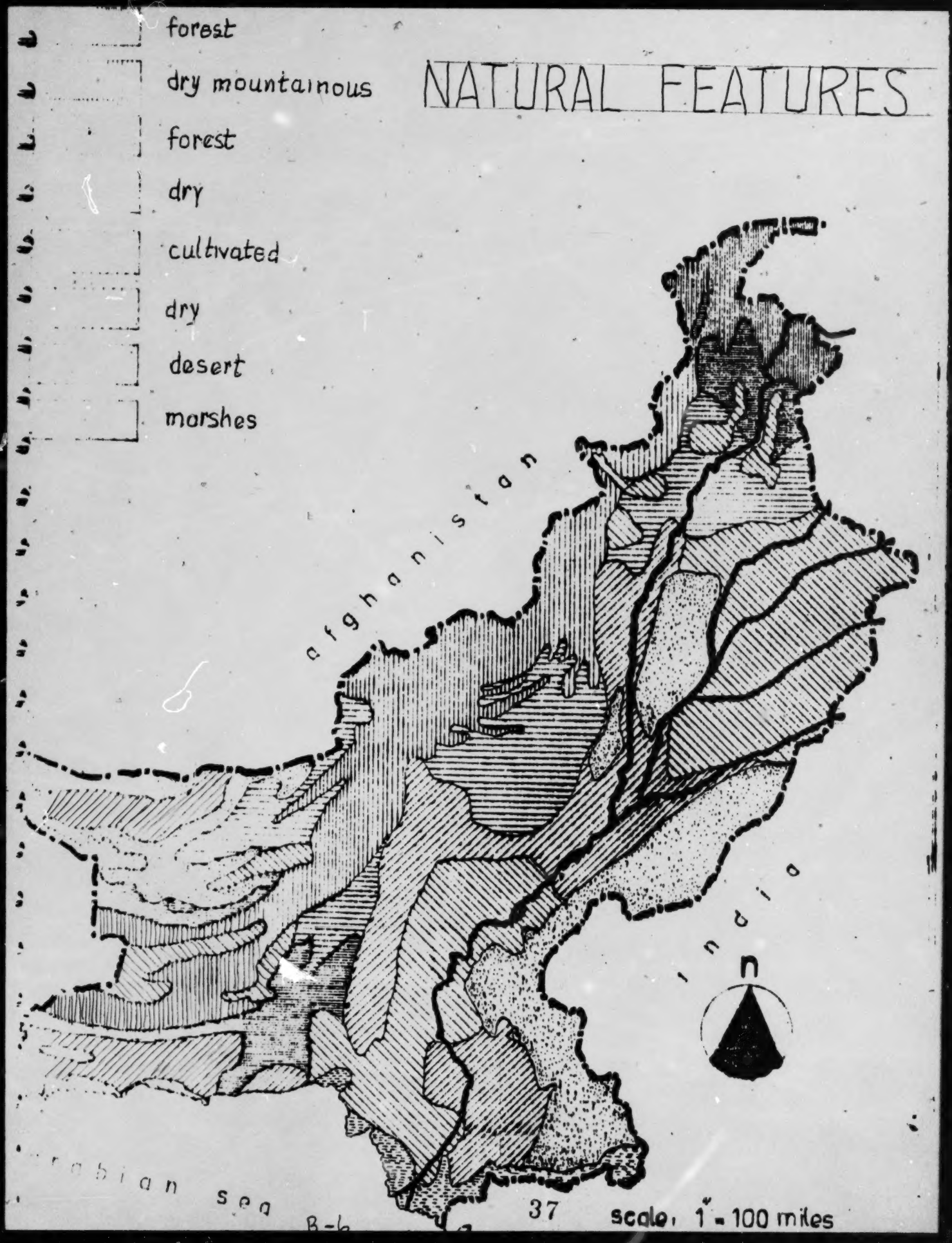
3 1000 – 3000 Ft

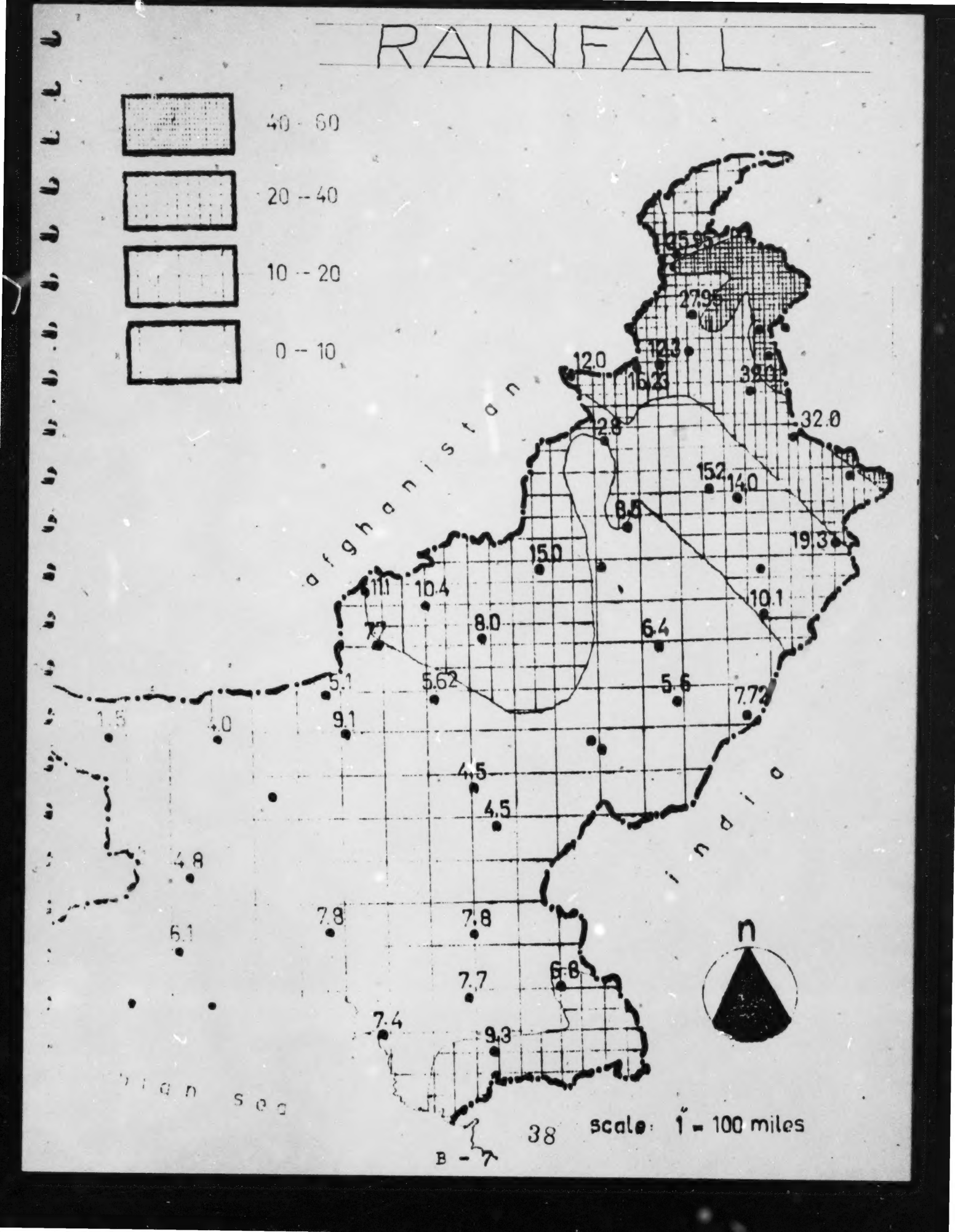
4 –3000 – 6000 Ft

5 –6000 – Ft

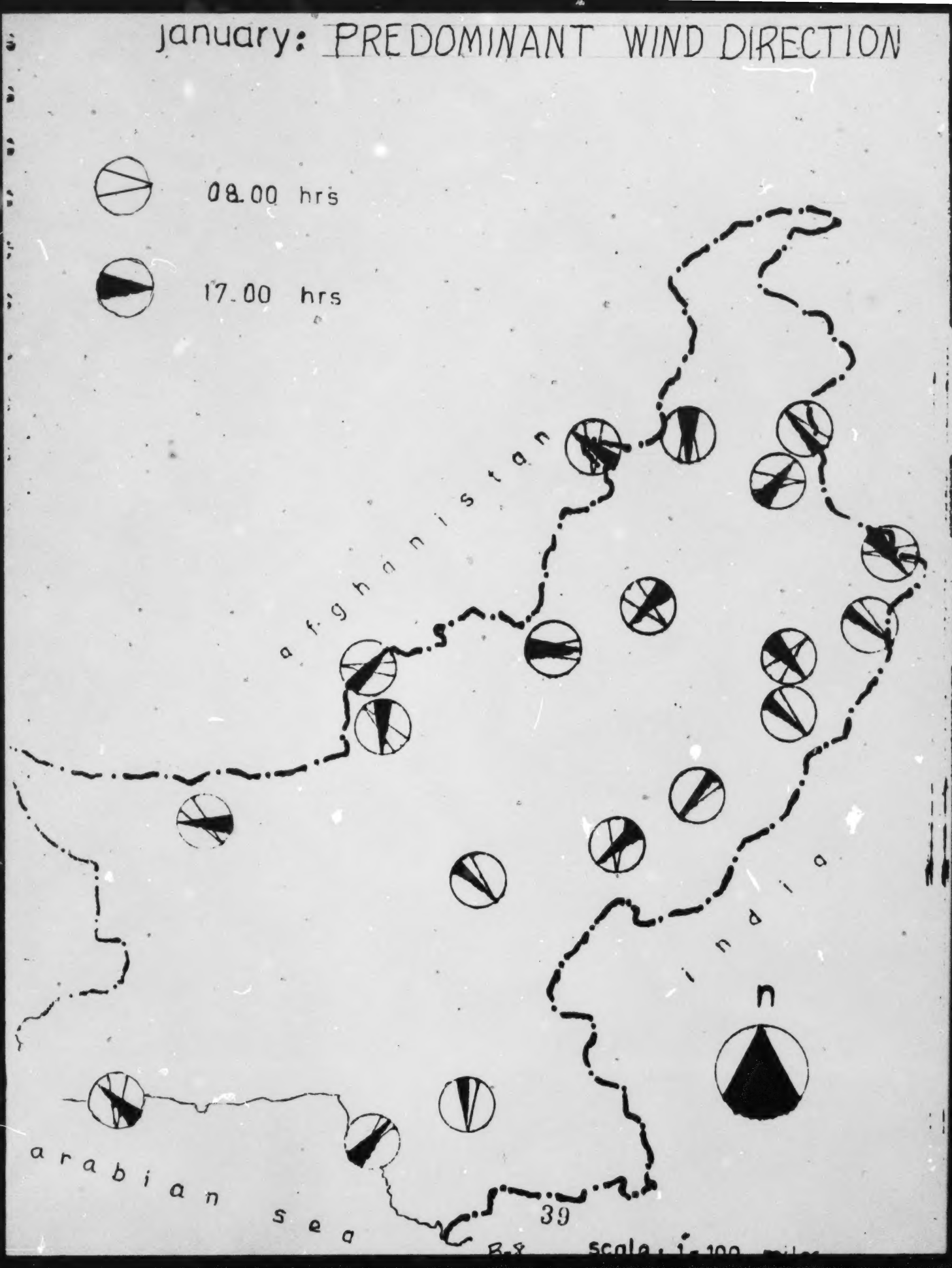


B-5 36 scale : 1"=100 miles


forest
dry mountainous
forest
dry
cultivated
dry
desert
marshes
NATURAL FEATURES
afghanistan
india
N
arabian sea
37
scale: 1" = 100 miles

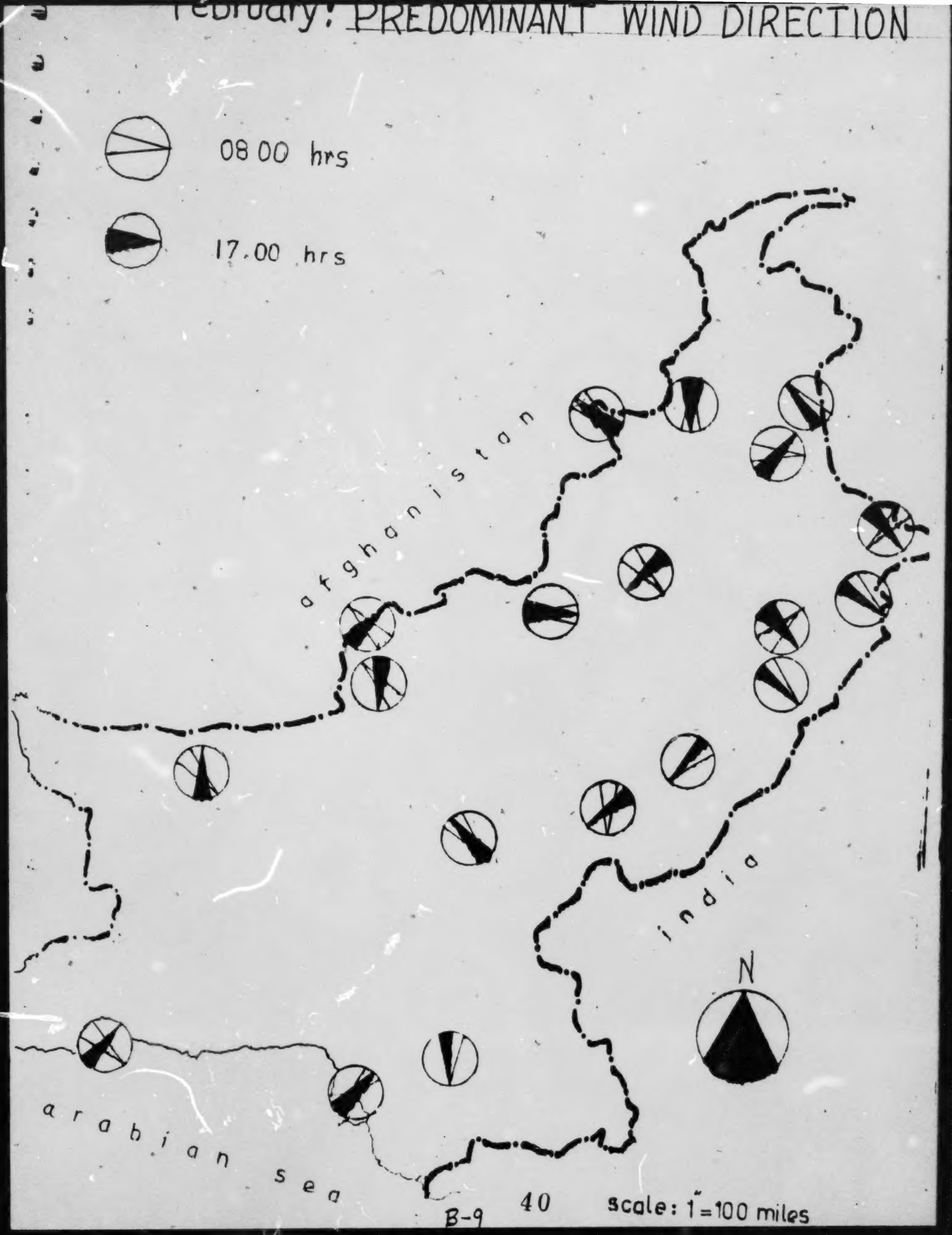

RAINFALL
40 - 60
20 - 40
10 - 20
0 - 10
Afghanistan
India
Arabian Sea
35.95
27.95
12.3
12.0
16.23
32.0
2.8
32.0
15.2
14.0
8.5
19.3
15.0
11.1
10.4
10.1
7.7
8.0
6.4
5.1
5.62
5.6
7.72
1.5
4.0
9.1
4.5
4.5
4.8
6.1
7.8
7.8
7.7
6.8
7.4
9.3
N
38
scale: 1" = 100 miles

January: PREDOMINANT WIND DIRECTION



B-8 scale: 1 = 100 miles

February: PREDOMINANT WIND DIRECTION



MARCH: PREDOMINANT WIND DIRECTION

08.00 hrs

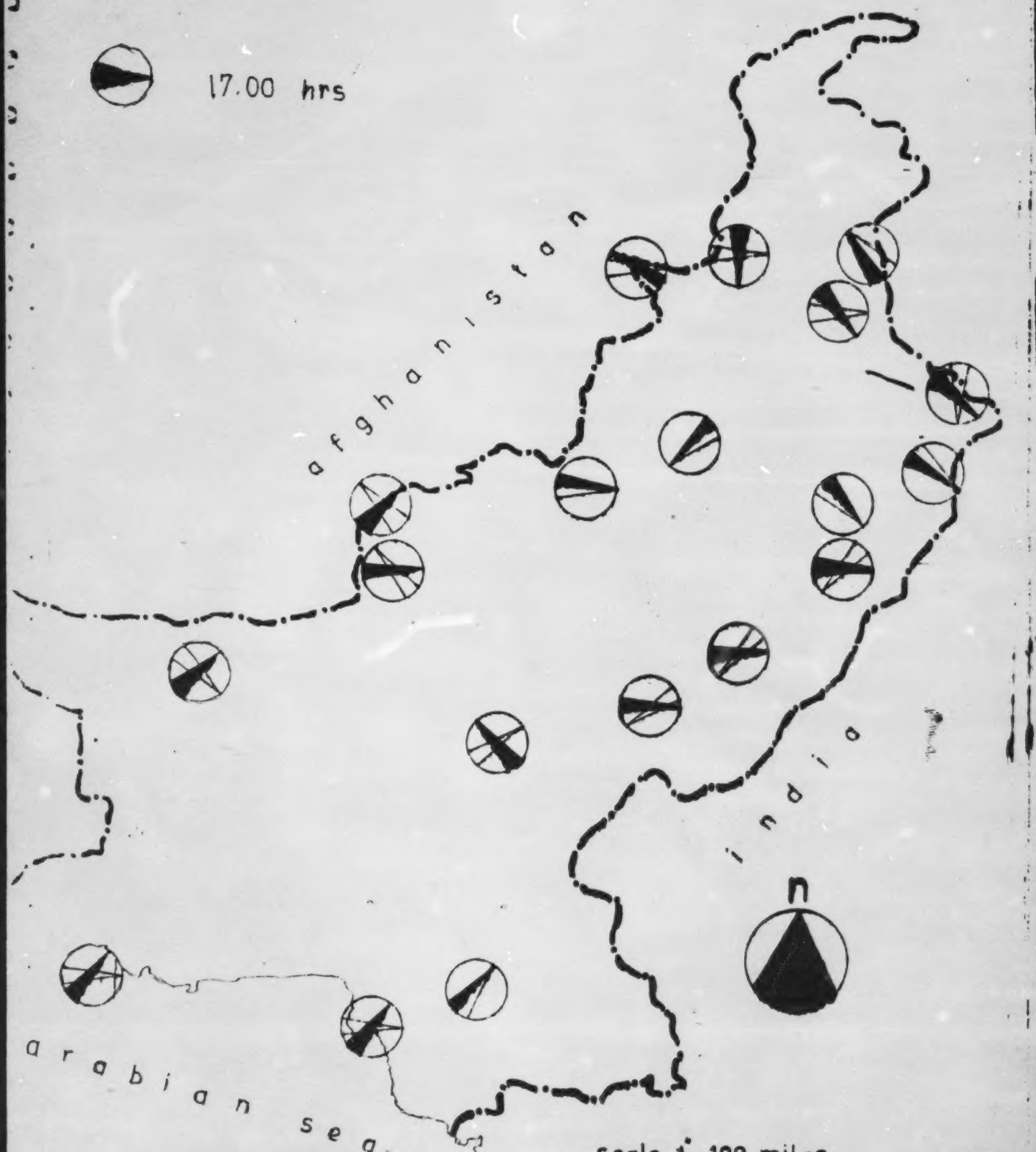
17.00 hrs

Scale: 1"=100 miles

APRIL: PREDOMINANT WIND DIRECTION

08.00 hrs

17.00 hrs

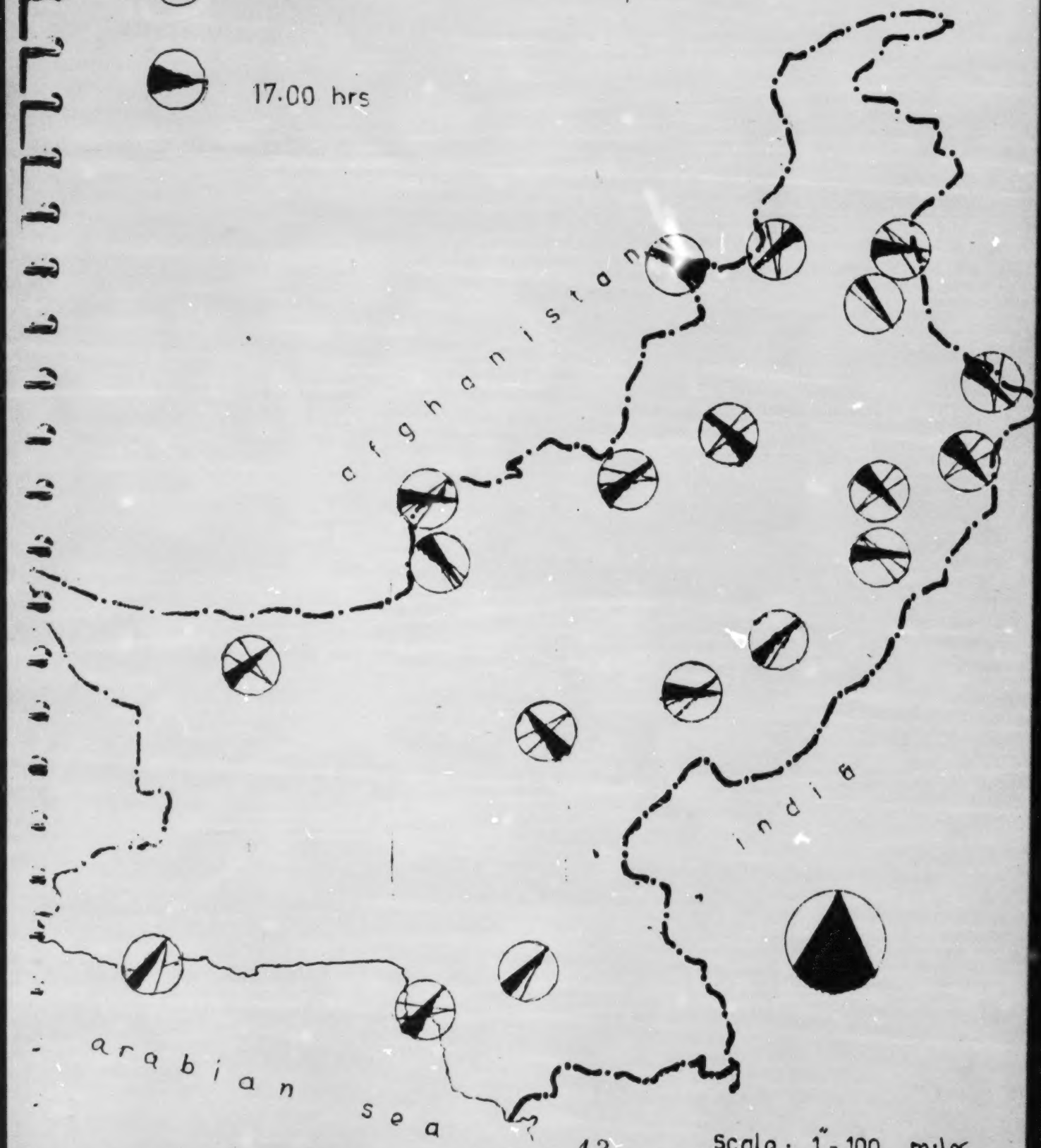


scale: 1" = 100 miles

MAY : PREDOMINANT WIND DIRECTION

08.00 hrs

17.00 hrs

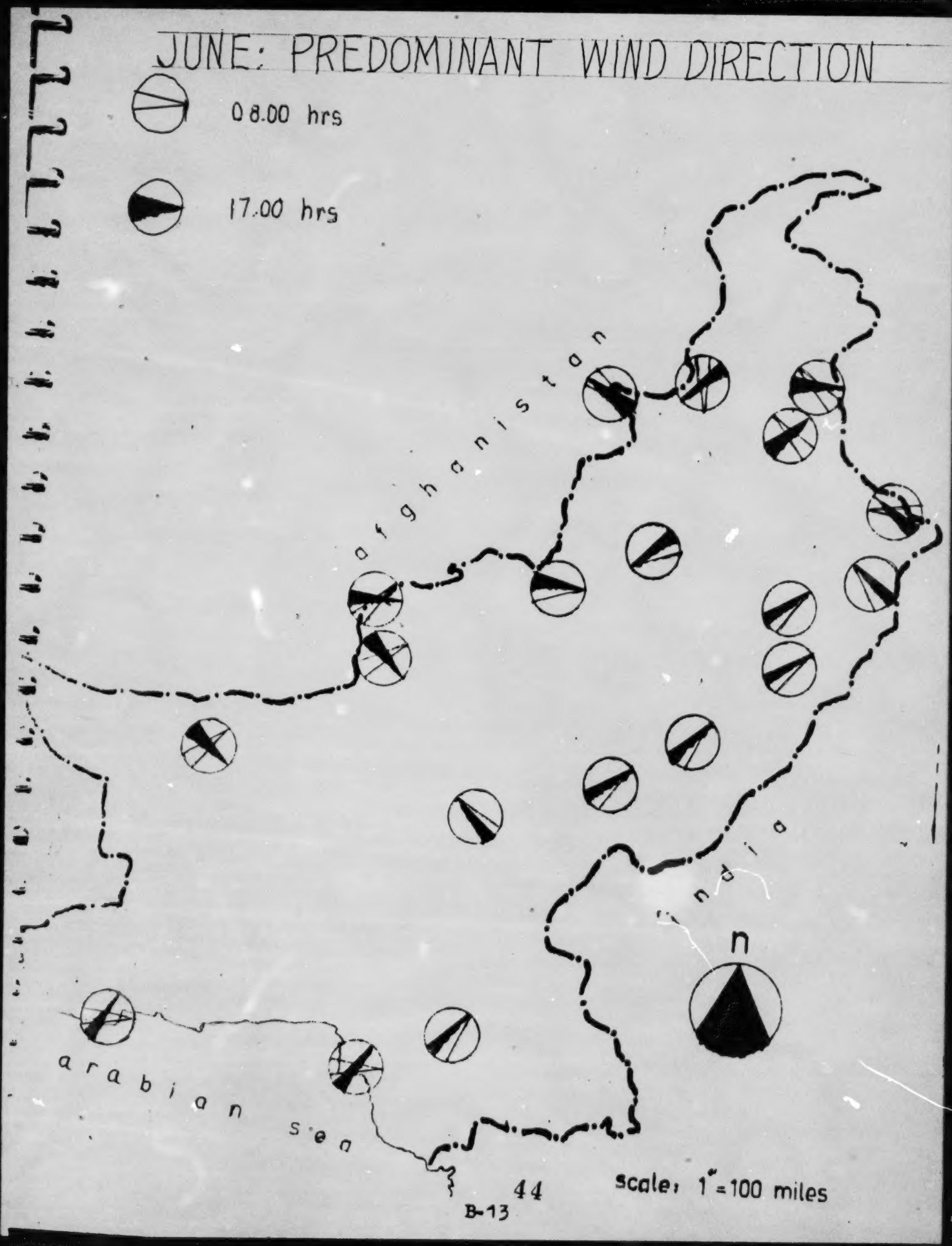


Scale : 1" = 100 miles

JUNE: PREDOMINANT WIND DIRECTION

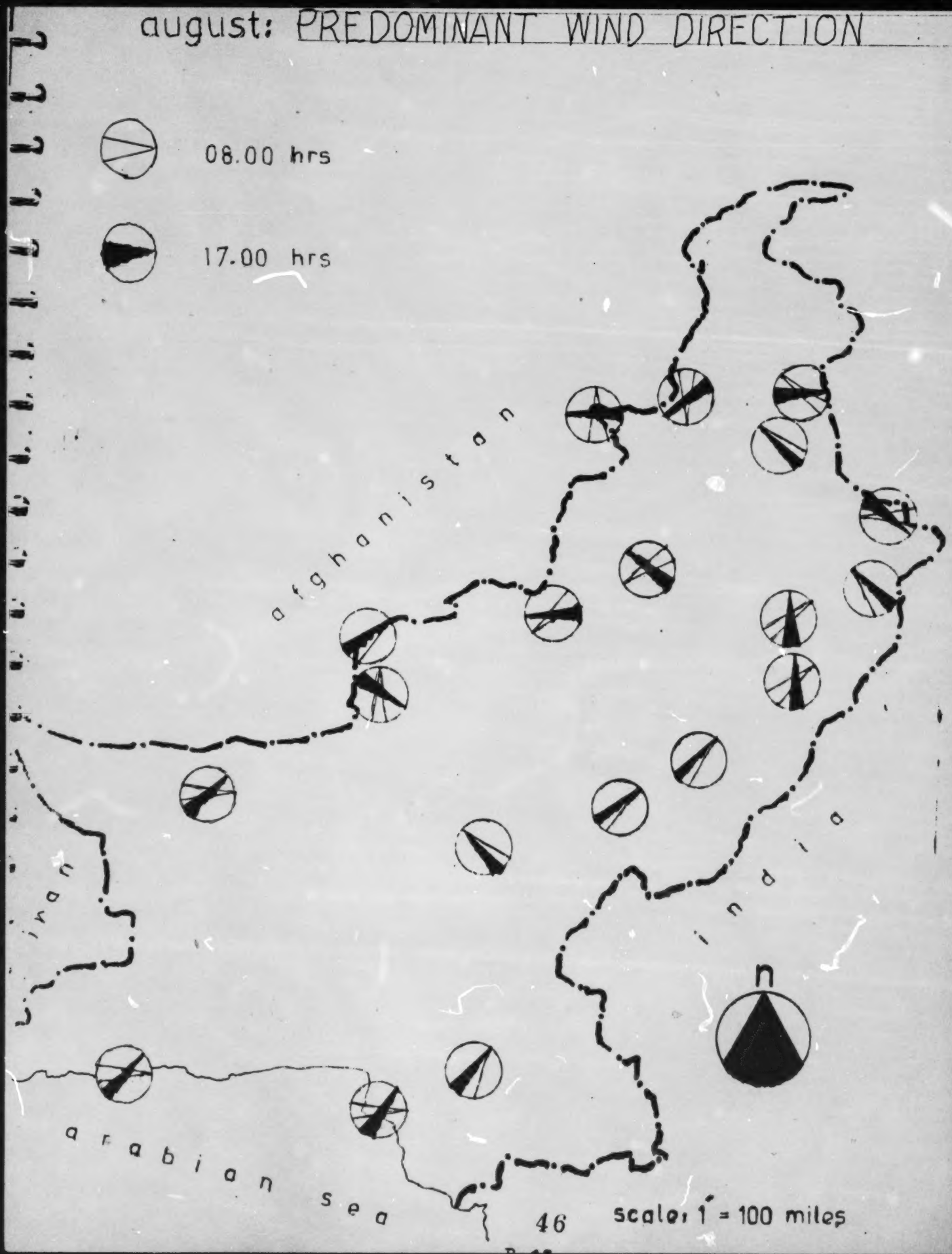
08.00 hrs

17.00 hrs



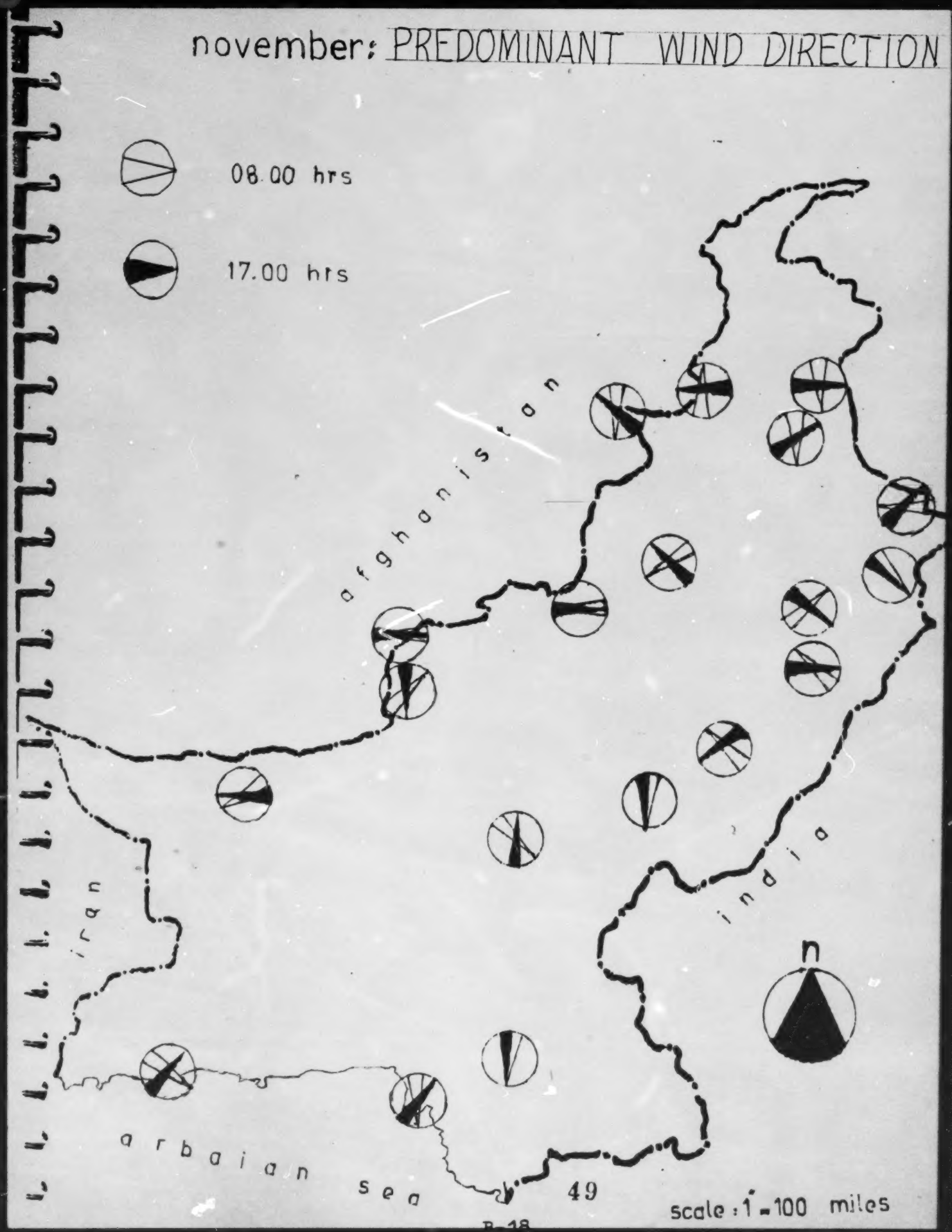
scale: 1" = 100 miles

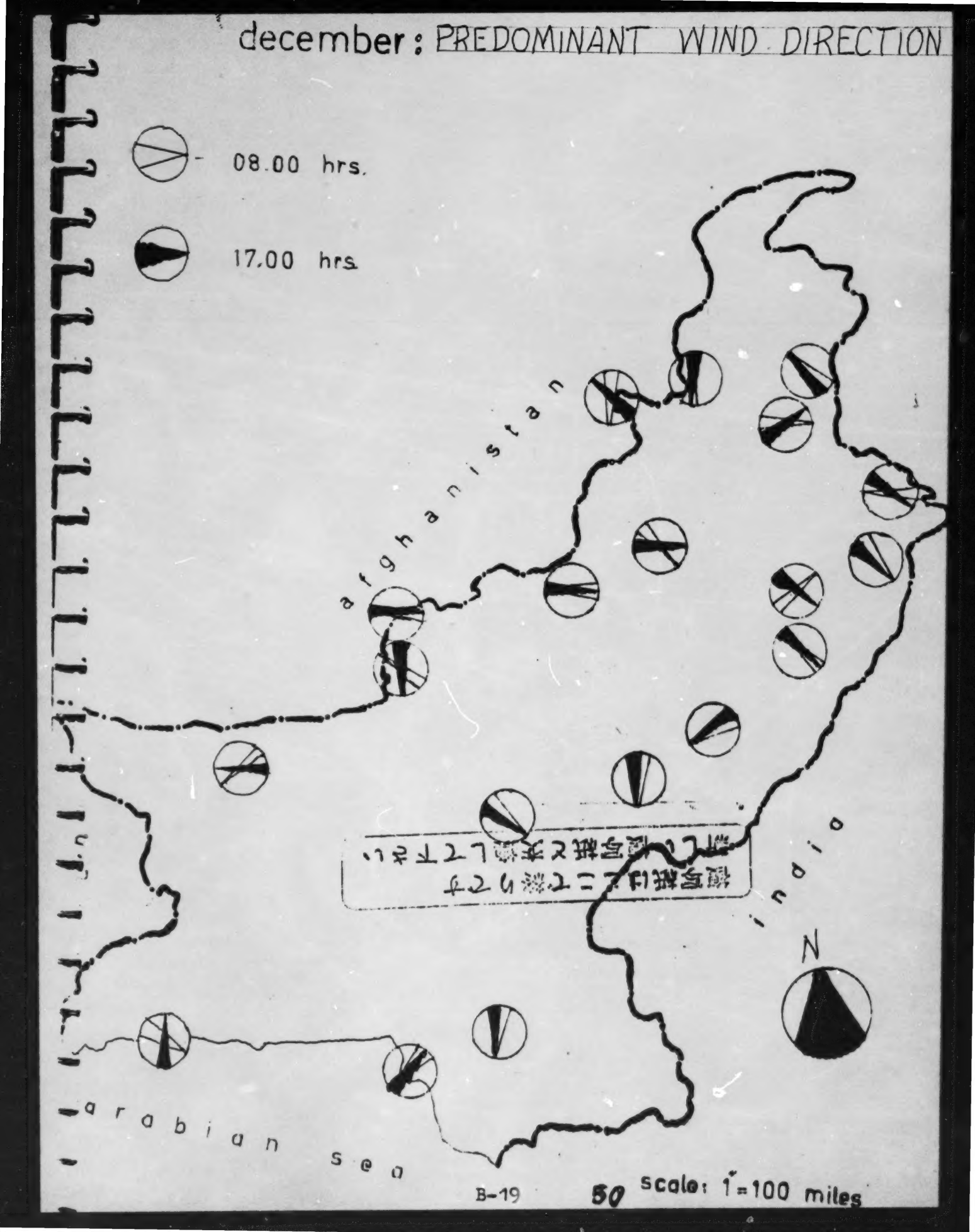
July: PREDOMINANT WIND DIRECTION
08.00 hrs
17.00 hrs
afghanistan
india
n
arabian sea
45
scale: 1-100 miles


august: PREDOMINANT WIND DIRECTION
08.00 hrs
17.00 hrs
afghanistan
india
arabian sea
n
scale: 1" = 100 miles

september: PREDOMINANT WIND DIRECTION
08.00 hrs
17.00 hrs
Afghanistan
India
Iran
Arabian sea
N
47
scale: 1" 100 miles

october: PREDOMINANT WIND DIRECTION
08.00 hrs
17.00 hrs
afghanistan
india
arabian sea
n
48
scale: 1"-100 miles


november: PREDOMINANT WIND DIRECTION
08.00 hrs
17.00 hrs
afghanistan
iran
india
arbaian sea
n
49
scale : 1 - 100 miles


december: PREDOMINANT WIND DIRECTION
08.00 hrs.
17.00 hrs.
afghanistan
india
arabian sea
N
複写紙はここで終わりです
残りは複写紙と交換してください
B-19
50
scale: 1"=100 miles

APPENDIX C

MATERIALS AND STRUCTURAL REQUIREMENTS

BUILDING MATERIALS AND SKILLS

REASONS FOR USE OF LOCAL BUILDING MATERIALS AND SKILLS.

ECONOMIC FACTORS:

i. Saving on cost.

ii. Uplift of rural economy.

iii. Reduction of rural unemployment by mobilizing local labor and skills.

iv. Reduction of transportation problems.

SOCIAL FACTORS:

i. Motivation towards Education.

ii. Encouragement of selfhelp/cooperative efforts.

iii. Social and idological uplift.

EVOLUTION OF PREVALENT PRINCIPAL BUILDING TYPES:

i. Calculation of percentage of different materials used in roof and walls by districts (from District Census Reports 1961) refer to Table No:

ii. Comparison of percentages led to the evolution of 3 most predominantly used materials in roofs and walls by Districts. (from District Census Reports 1961), refer to Table No:

iii. Comparing the above data with visual and photographic data compiled through Field Survey (refer to sketches of building in different rural areas of Pakistan). Following major building types were evolved: (refer to Table No:).

Building Type	Wall	Roof
A	Mud/Sundried Bricks	Wood/Mudthatch
B	Stone/Mud	Wood/Mudthatch
C	Burnt Bricks	Wood/Mudthatch
D	Wood	Wood/Mudthatch
E	Thatch	Wood/Mudthatch
F	Mud/Sundried Bricks	Bamboo/Thatch
G	Stone/Mud	Bamboo/Thatch
H	Wood	Bamboo/Thatch
I	Thatch	Bamboo/Thatch

STRUCTURAL REQUIREMENTS

DEPEND UPON:

1. Materials and Technology available.

   The table on frequency of occurrence of various building types at District level is made redundant, as the various conditions at specific localities (of materials used) may be completely different. Hence all material possibilities are considered for structural requirements.

2. Spacial requirements:

   (Refer to population growth and Educational Methods.)

STRUCTURAL SOLUTIONS WERE EVOLVED:

The following structural solutions were evolved considering:

— local materials, local skills.
— local materials, imported skills, and
— imported materials, imported skills.

1. The following SPAN TYPES were evolved:

   i. Clear Spans:

Span type A	Simple timber beam - 20'
Span type B	Timber truss 20'
Span type C	Arch. 20'
Span type D	Steel truss 20'

   ii. Interrupted Spans:

Span type E	Timber beam - 13' .4" with one row of columns on one side of the classroom.
Span type F	Timber beam - 10' with one row of columns in the center of classroom.
Span type G	Timber beam - 6'.8" with two rows of columns in the classroom.

STRUCTURAL REQUIREMENTS (CONTD)

2. SECONDARY SPAN:

Length of secondary spanning member is 6'.8" due to easy availability. It may be covered by locally available covering materials; e.g., Thatch, Chatai, Reeds, etc.

3. GRID: (6'.8" x 6'.8")

Because sub-multiple of classrooms size, and easy availability of 6'.8" long spanning member - 6'.8" x 6'.8" Grid is employed.

4. WALL TYPES:

External wall - will depend upon climate, materials, and load.
Low wall - will depend upon materials.
Retaining wall - will depend upon materials and Thurst.
Internal wall - will depend upon materials.

TYPES WALLS

A. CLAY/SUN DRIED BRICKS
B. STONE / MUD
C. BURNED BRICK
D. WOOD
E. TATCH
F. CLAY
G. STONE MUD
H. WOOD
I. TATCH

ROOFS.

WOOD / MUD TATCH.
" " "
" " "
" " "
" " "

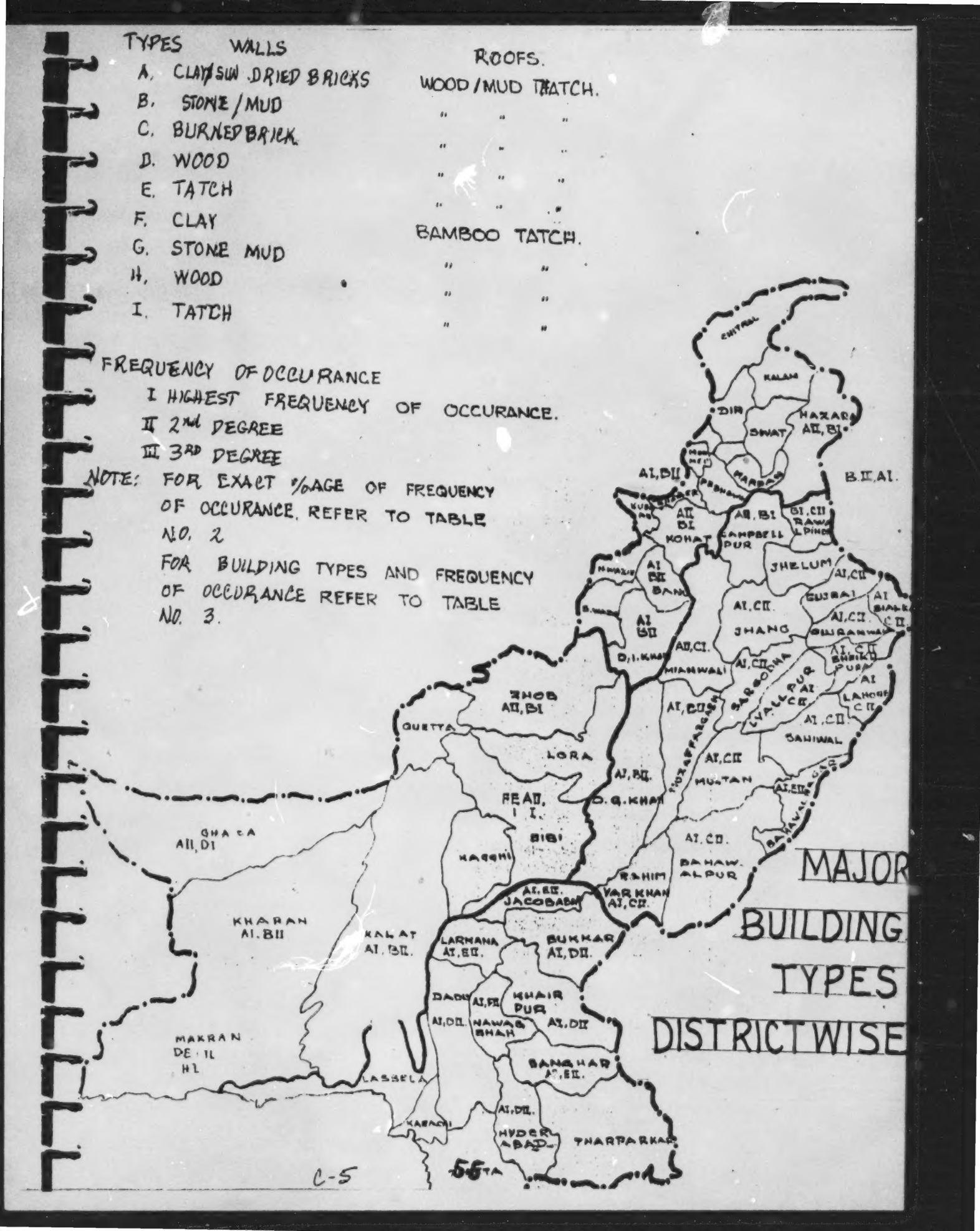
BAMBOO TATCH.
" "
" "
" "

FREQUENCY OF OCCURANCE

I HIGHEST FREQUENCY OF OCCURANCE.
II 2nd DEGREE
III 3RD DEGREE

NOTE: FOR EXACT %AGE OF FREQUENCY OF OCCURANCE, REFER TO TABLE NO. 2

FOR BUILDING TYPES AND FREQUENCY OF OCCURANCE REFER TO TABLE NO. 3.



C-5

55TA

EXPLANATORY NOTES
BUILDING ELEMENT

TYPES	WALL	ROOF
A.	MUD/SUN DRIED BRICKS	WOOD/MUD THATCH
B.	STONE MUD	WOOD/MUD THATCH
C.	BURNT BRICKS	"
D.	WOOD	" "
E	THATCH	"
F.	MUD/SUN DRIED BRICKS	BAMBOO THATCH
G	STONE MUD	"
H.	WOOD	"
I.	THATCH	"

page C-6 duplicate of page C-5.

TABLE 2(CONTD)

		WAAL					ROOF						
N.W.F.P	PRIORITY	B.B.	S.M.	K.B.	W.	T	G.I.A.	B.B.	S.T.	W.	B.T.	M.T.	O
HAZARA	I												
	II												
	III												
MARDAN.	I			57.11									
	II		36.48				7.31			82.75			
	III	6.13										3.39	
PESHAWAR.	I			77.45									
	II		17.81							90.38			
	III	4.05						1.45				6.66	
KOHAT	I		82.23										
	II			15.88								77.06	
	III	1.63						0.61		21.48			
BANNU	I			91.38									
	II		7.36									80.61	
	III	0.66									2.74		
D.I.KHAN.	I			60.11									
	II		9.72									80.44	
	III	0.69								15.78			
												1.95	

TABLE 2(CONTD).

		WALL						ROOF					
BALUCHISTAN	PRIORITY	B.B.	S.M.	K.B.	W.	T	G.I.A.	B.B.	B.T.I	W.	B.T.	M.T.	O
	I				40.0					66.2			
CHAGAI	II			29.5							16.6		
	III											11.9	
	I		77.0									31.5	
ZHOB	II			21.3						25.9			
	III												13.8
	I			35.9						53.8			
KHARAN	II				32.6							38.0	
	III					16.6							5.7
	I			79.6								53.3	
KALAT	II		8.4							33.0			
	III						6.9						
	I				47-8						39.4		
MERRAN	II					37.0						32.8	
	III			11.3						23.3			

C-10

TABLE
2(CONTD)

		WALL					ROOF					
SIND	PRIORITY	B.B.	S.M.	K.B.	W.	T.	G.I.A.	B.B.	B.T?I.	W.	B.T.	M.T.
SANGHAR	I			60.60								55.0
	II					22.6				16.06		
	III				7.61						14.0	
THARPARKAR	I			71.77						68.0		
	II					11.33						20.10
	III				11.19						5.51	
BALUCHISTAN												
LASBELA	I				[illegible]	56.28					41.3	
	II			28.51								38.57
	III				11.86					17.0		
SIBI	I					48-0					53.3	
	II			30;7								32.4
	III		18.0							11.07		
QUETTA	I											
	II											
	III											
LORALAI	I		37.0									44.6
	II			[illegible]							34.5	
	III				4.0					19.3		

TABLE 2(CONTD)

		WALL					ROOF						
SIND	PRIORITY	B.B.	S.M.	K.B.	M.	T	G.I.A.	B.B.	B.T.I.	M.	B.T.	M.T.	O
SUKKUR	I			68.66								53.1	
	II				13.38					24.0			
	III					11.11							9.75
LARKANA	I			61.10								43.1	
	II					16.46				25.6			
	III				9.91								17.2
JACOBABAD	I			41.30								63.20	
	II					29.14				13.53			
	III				20.20						12.82		
NAWABSHAH	I			84.39								51.5	
	II					8.38					21.07		
	III	3.23								18.48			
HYDERABAD	I			62.61								39.57	
	II				27.29					32.74			
	III					8.24							10.65
ADU	I			63.93								45.09	
	II				15.51					32.51			
	III					6.57					13.29		

C-12

TABLE 2(CONTD)

		WALL					ROOF					
PUNJAB	PRIORITY	B.B.	S.M.	K.B.	.W.	T.	G.I.A.	B.B.	B.T.I.	W.	B.T.	M.T O
MULTAN	I			93.6								75.8
	II	4.93								8.30		
	III		.86								6.74	
	I			8.77								83.3
[illegible]MIANWARGARH	II	9.34								4.93		
	III					1.48		4.87				
	I			83.8								62.7
[illegible]G.KHAN	II		5.9							31.14		
	III	3.28										2.72
	I			91.75								73.18
[illegible]WALINAGAR	II					3.54				14.64		
	III	3.10									6.56	
	I			89.35								79.01
[illegible]ALPUR	II	4.62						5.48				
	III									4.93		
	I			84.66								69.62
[illegible]YAR KHAN	II									11.56		
	III	0.49							7.78			
[illegible]	I											
	I			72.57								54.00
[illegible]AFGH	II				10.17							

65

66

Table 2(CONTD)

PUNJAB	PRIORITY	WALL B.B.	WALL S.M.	WALL n.b.	WALL W.	WALL T.	ROOF G.I.A.	ROOF B.B.	ROOF B.T.	ROOF W.	ROOF B.T.	ROOF H.T.	ROOF 0
HANG	I												
	II	4.11		94.11									
	III		1.86										77.33
FALLPUR	I									15.48			
	II	6.4		92.0				8.41			2.73		
	III		1.17										65.85
SIALKOT	I									19.55			
	II	18.13		79.98							6.41		
	III		1.16							94.34			
GUJRANWALA	I												
	II	17.05		81.63			1.68						14.69
	III		0.89							89.7			
SHEIKHUPURA	I												
	II	9.69		89.0			0.37						8.37
	III		0.75										50.44
GURDASPUR	I									40.58			
	II	9.32		89.5							4.49		
	III				1.11								56.9
[illegible]	I									35.9			
	II	[illegible]		[illegible]7							2.86		
	III				[illegible]6		4.62		26.32				60.97

TABLE NO 2 SHOWING THE FIRST THREE DOMINANT BUILDING MATERIALS USED IN ROOFS AND WALLS BY DISTRICTS (IN PERCENTAGE).

		WALL					ROOF					
PUNJAB	Priority	B.B.	S.M.	K.B.	W.	T.	G.I.A.	B.B.	B.T.	W.	B.T.	M.T.
RAWALPINDI	I		55.4							92.6		
	II	34.1										3.8
	III			3.9				2.0				
CAMPBELLPUR	I		69.55							94.0		
	II			18.10								4.95
	III	12.16						1.80				
GUJRAT	I			53.9						91.7		
	II	43.07										4.95
	III		2.71					1.80				
J[illegible]	I											
	II											
	III											
[illegible]	I	69.48										
	II			25.21								58.13
	III		4.56							25.54		
											7.06	
69	I			3.92								
	II	18.[illegible]										
	III		[illegible]							40.[illegible]		

70

TABLE 1(CONTD)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
N.W.F.P.															
Hazara	3.2	90.0	5.4	0.05	0.02	0.0	0.0	0.2	0.3	0.1	5.9	88.3	0.1	5.0	0.2
aruan	6.13	36.48	57.11	0.14	0.00	0.06	0.01	0.09	2.45	0.29	7.31	82.75	1.02	3.39	2.7
eshawar	4.05	7.81	77.45	0.07	0.13	0.01	0.01	0.14	1.45	0.14	0.05	90.38	0.81	6.66	0.5
ohat	1.63	82.23	15.88	0.00	0.00	0.07	0.00	0.14	0.61	0.03	0.06	21.48	0.05	77.66	0.06
nnu	0.66	7.38	91.38	0.02	0.00	0.00	0.16	0.42	1.12	0.34	0.00	2.44	2.74	80.64	12.64
I.Khan	0.69	9.72	88.11	0.00	0.00	0.1	0.6	0.03	0.37	0.23	0.04	15.78	0.98	80.44	1.95
Tribal Agencies															

TABLE I.C: 1 SHOWING PRINCIPLE BUILDING MATERIALS USED IN ROOFS AND WALLS BY DISTRICTS.(IN PERCENTAGE)

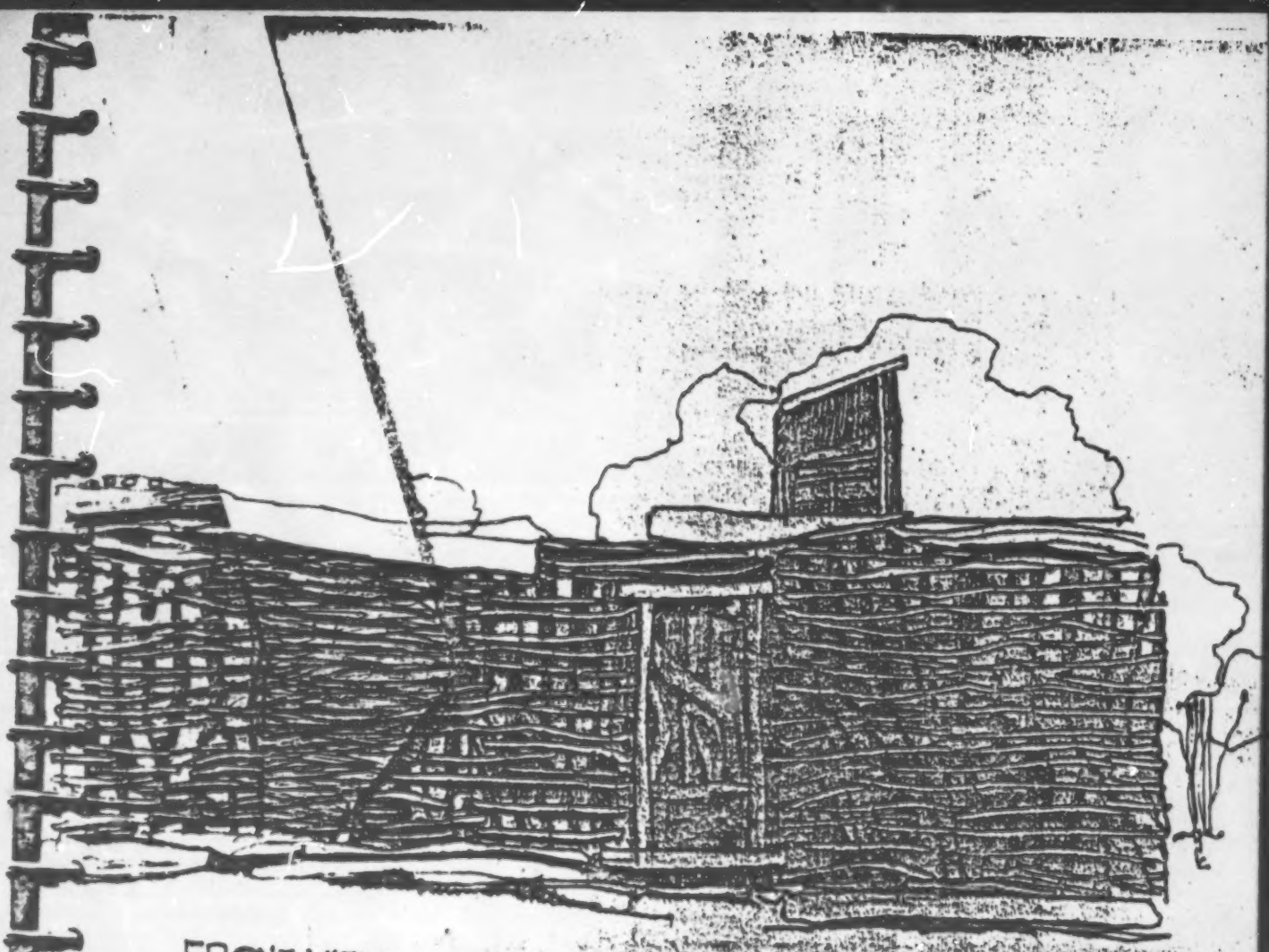
DISTRICTS	WALL								ROOF						
	CONCRETE BAKED BRICKS STONE CEMENT	MUD STONE	EARTH KUTCHA BRICKS	G.I. ABBES-TOS.	WOOD	BAMBOO	THATCH	OTHER	CONCRETE BAKED BRICK STONE	BAKED TILES	G.I. ABBES-TOS	WOOD	BAMBOO THATCH	MUD THATCH	OTHERS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DISTT	BB	SM	AB	GIA	W	B	T	OTHER	BB	BT	GIA	W	BT	MT	OTHER
1. Rawalpindi.	34.1	55.4	3.9	0.01	0.0	0.0	0.0	0.05	2.0	1.0	0.5	92.6	1.0	3.8	0.2
2. Jhelum.	12.16	69.55	16.10	0.03	0.02	0.0	0.0	0.12	0.76	0.61	0.02	94.02	0.23	3.99	0.33
3. Attock.	43.07	2.71	53.95	0.04	0.02	0.0	0.01	0.18	0.91	0.8	0.12	91.71	0.3	4.95	0.13
4. Mianwali.	69.48	4. 56	25.21	0.01	0.06	0.03	0.5	0.13	0.72	5.98	0.71	25.54	7.06	58.13	1.8
5. Sargodha.	18.46	7.14	73.92	0.02	0.08	0.06	0.15	0.13	1.40	5.79	0.26	40.14	1.67	50.28	0.37
6. Khushab.	4.11	0.66	94.11	0.01	0.02	0.02	0.04	0.02	1.16	2.65	0.09	15.48	2.73	75.33	0.44
7. Bhakkar.	10.13	1.16	79.16	0.08	0.12	0.06	0.1	0.06	1.31	2.71	0.24	19.55	0.41	65.86	0.88
8. Jhang.	7.65	0.69	91.63	0.05	0.05	0.01	0.23	0.32	0.01	1.66	0.19	96.34	0.73	14.69	0.38
9. Gujrat.	0.02	0.75	99.05	0.12	0.002	0.03	0.02	0.02	0.27	0.24	0.16	89.7	1.03	8.37	0.18
10. Sialkot.	0.02	0.01	0.03	0.12	0.05	0.01	1.11	0.1	1.03	2.25	0.13	80.5	4.49	50.44	1.00
11. Gujranwala.	0.04	0.03	0.02	0.1	0.12	0.04	1.12	0.15	0.23	2.04	0.21	35.98	2.86	56.98	0.98
12. Lahore.	0.04	0.01	0.01	0.1	0.1	0.03	0.02	0.12	1.08	4.82	0.10	20.02	4.30	60.97	0.6
13. Sheikhupura.	0.01	0.01	0.01	0.03	0.04	0.02	0.03	0.27	1.31	5.06	0.12	8.30	0.74	75.83	2.93
14. Nankana Sahib.	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.21	2.61	4.87	0.1	4.93	2.4	83.34	2.24
15. Sheikhupura.	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.1	0.02	2.55	0.07	1.1	1.1		

TABLE -1(Contd)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bahawalnagar	3.1	0.3	91.75	0.04	0.84	0.07	3.54	0.12	1.04	1.15	0.13	14.64	6.58	73.18	3.21
Bahawalpur.	4.62	1.41	89.35	0.03	0.12	0.06	1.77	2.59	1.96	5.68	0.2	4.93	4.24	79.01	4.51
Rahimyar Khan	10.43	0.76	84.66	0.02	0.52	0-05	1.75	1.75	1.54	7.87	0.45	11.56	5.51	69.62	3.26
S I N D															
Khairpur.	3.03	0.47	72.57	0.34	18-42	0.62	16.6	4.67	2.7	0.8	0.1	10.4	8.2	54.7	22.9
Sukkur	3.69	0.34	68.66	0.23	12.3	0.4	11.11	3.14	3.3	0.4	0.2	24.0	9.0	53.1	9.7
Jacobabad	3.83	0.09	41.3	0.05	20.29	0.12	29.14	5.12	2.8	0.3	0.1	13.5	12.9	68.2	7.0
Larkana	1.72	0.14	81.1	0.05	9.91	0.19	15.46	11.39	0.9	0.2	0.2	25.6	12.7	43.1	17.2
Nawabshah	3.23	0.1	84.39	0.04	2.52	0.17	8.28	1.14	4.6	0.83	0.4	18.5	21.1	51.5	3.07
Hyderabad	3.59	0.45	62.61	0.08	27.29	0.24	8.24	4.80	3.4	0.7	0.0	32.7	8.0	39.5	15.5
Dadu	3.47	1.24	83.93	0.69	51.51	0.13	8.5	2.83	3.2	0.5	0.8	32.5	13.2	45.00	5.0
Sanghar	3.44	0.54	60.61	0.05	7.61	0.35	22.6	4.75	4.5	1.3	0.6	16.0	14.0	55.0	8.3
Thar Parkar	2.78	0.85	71.77	0.10	11.19	0.16	11.33	1.80	2.4	1.0	0.7	68.0	5.5	20.0	2.4
Las Bela	0.78	1.32	29.5	0.09	11.86	0.12	65.26	1.02	0.64	0.09	0.09	17.0	41.3	38.5	2.3
Khat[illegible]															
BALUCHISTAN															
Sibi	14.8	13.0	30.7	0.006	0.54	0.1	28.0	0.39	0.2	0.2	1.5	11.07	53.3	32.4	1.4
Quetta															
Zor[illegible]wal	0.3	97.1	40.[illegible]	0.00	4.0	[illegible]	1.2	0.54	0.07	0.01	0.7	19.3	34.5	44.6	0.8
Kha[illegible]	0.14	4.2	42.5	2.15	40.4	[illegible]	7.2	0.8	0.05	0.01	1.06	66.2	16.1	11.5	5.0
Kho[illegible]	1.1	77.[illegible]	0.[illegible]	0.00	0.16	[illegible]	0.02	0.85	0.2	0.01	3.7	25.9	5.06	51.5	13.[illegible]
Kha[illegible]	0.16	7.7	91.[illegible]	1.8	3.[illegible]6	[illegible]	16.6	5.5	0.01	0.01	0.04	53.8	0.04	38.0	5.7
Kal[illegible]	0.59	2.4	72.[illegible]	0.5	3.30	[illegible]	1.1	0.57	0.3	0.04	0.9	33.00	6.8	53.3	2.3
Ka[illegible]	0.1	4.6	71.[illegible]	0.35	17.8	[illegible]	37.00	0.36	0.07	0.00	0.04	23.3	39.4	32.8	42

A P P E N D I X D

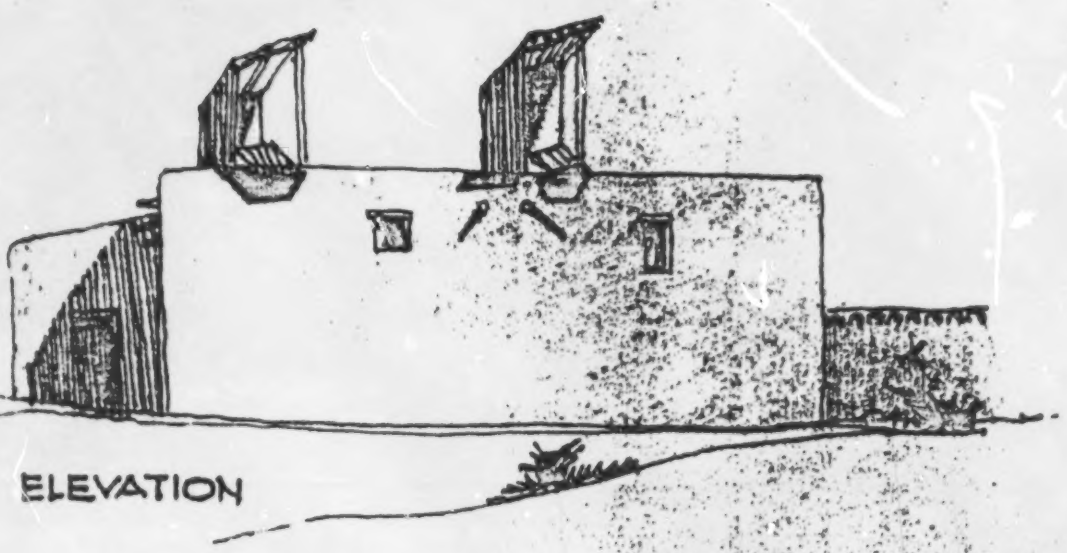
ILLUSTRATIVE TYPES OF CONSTRUCTION WITH VARIOUS MATERIALS AND WORKMANSHIP FOUND IN PAKISTAN



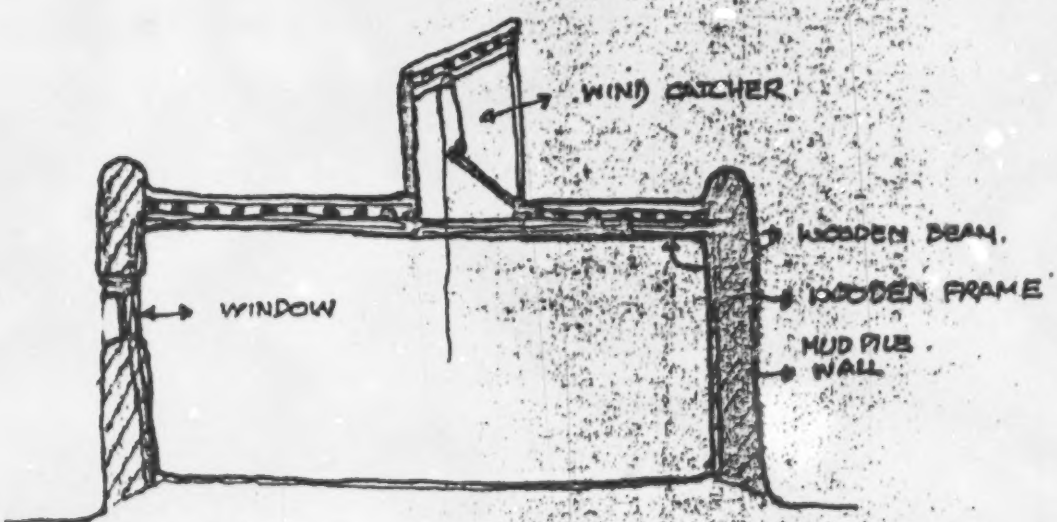
FRONT VIEW

LAI CONSTRUCTION
WOOD USED AS SPANNING SUPPORTING AND COVERING MATERIAL

D-2
78



ELEVATION

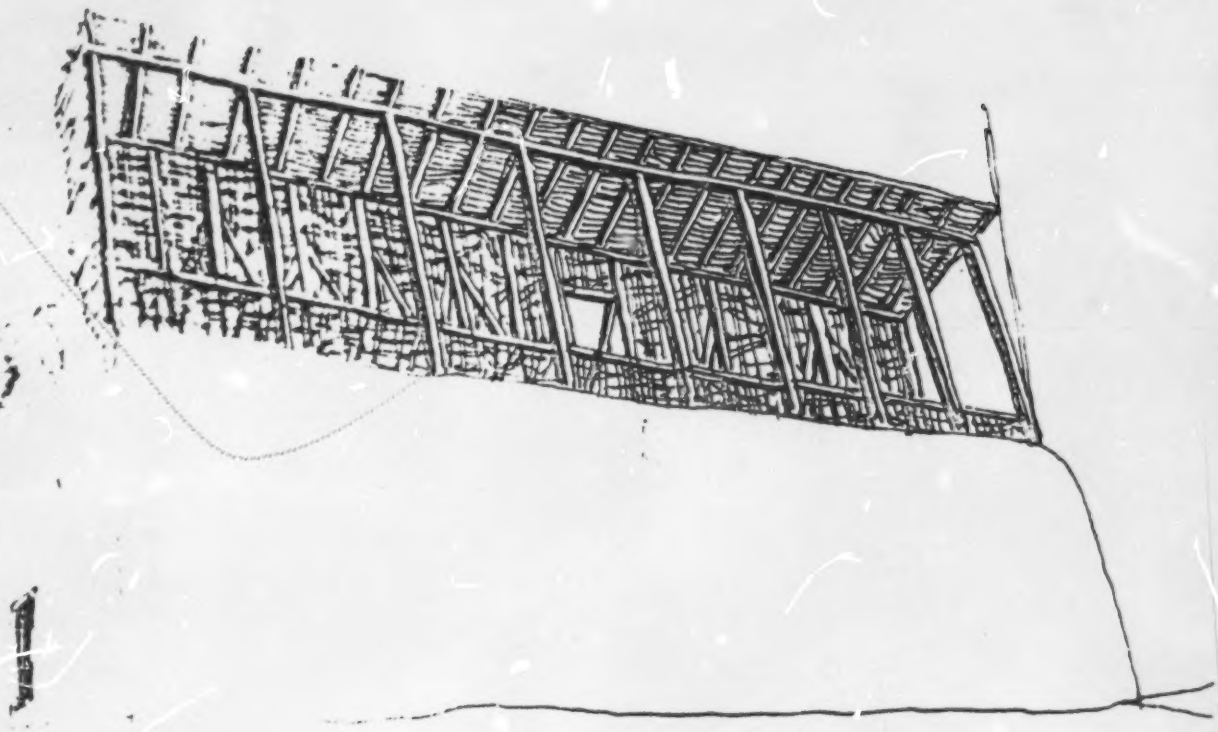


SECTION

MUD PILE WITH WOODEN FRAME CONST.

WOOD AS SPANNING & SUPPORTING MATERIAL &
MUD AS COVERING MATERIAL

D-3



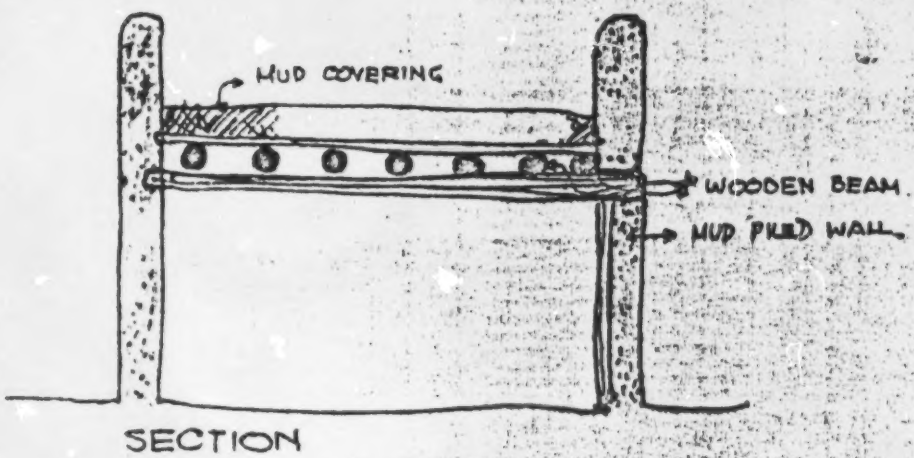
FRONT VIEW

MUD. WOOD CONSTRUCTION

WOOD AS SPANNING SUPPORTING & COVERING MATERIAL, MUD FOR [illegible] PURPOSE.

D-4

ELEVATION

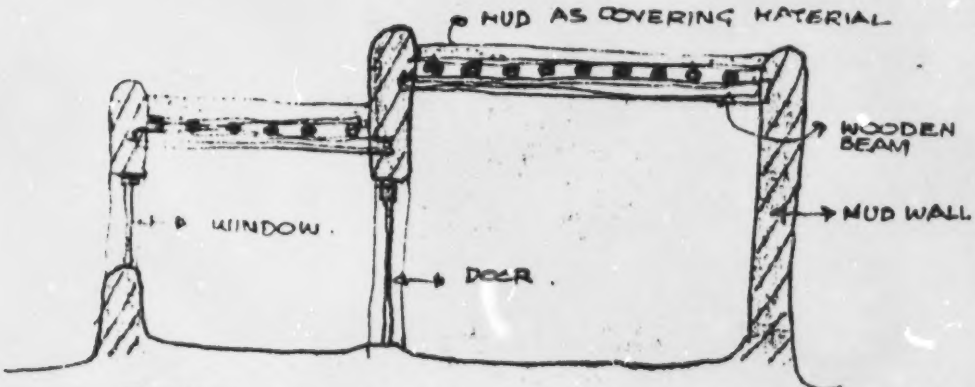


SECTION

MUD PILE CONSTRUCTION

WOOD AS SPANNING MATERIAL &
MUD AS SUPPORTING & COVERING MATERIAL

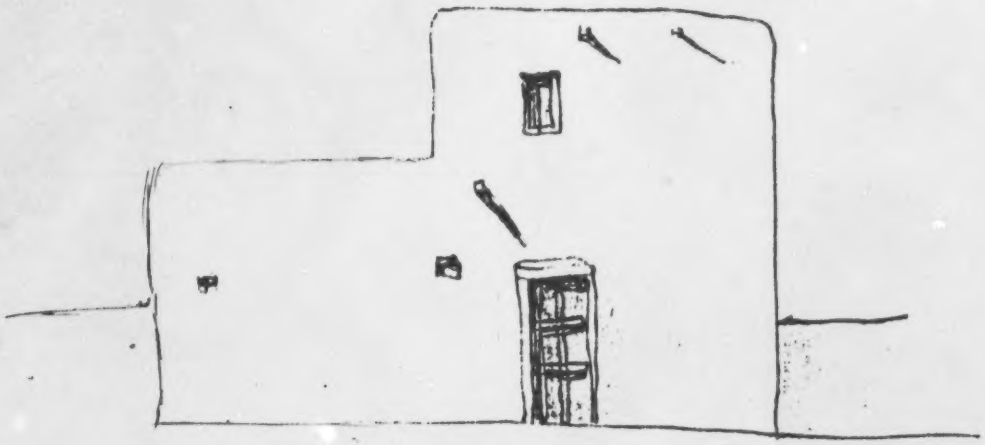
ELEVATION



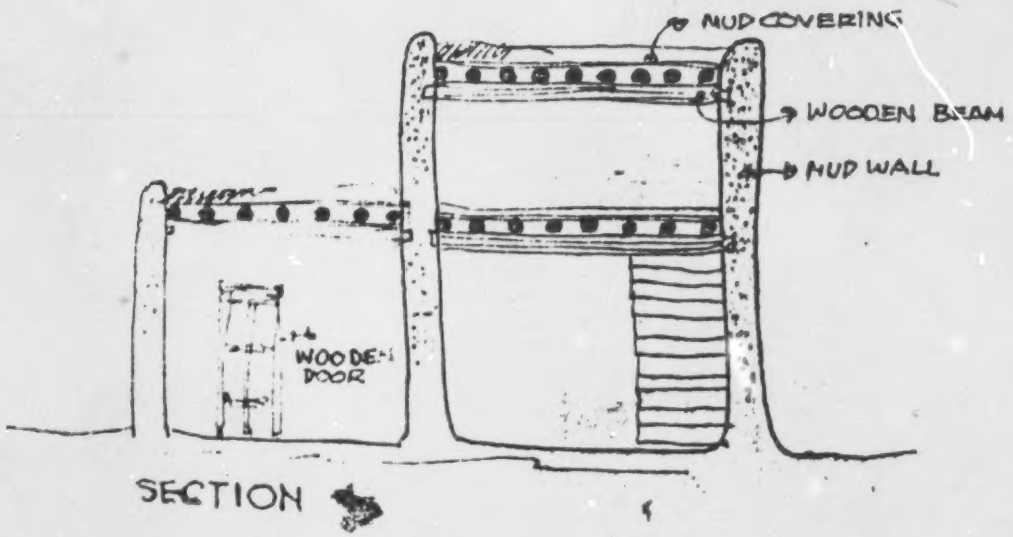
SECTION

MUD-PILE CONSTRUCTION

WOOD AS SPANNING MATERIAL & MUD PILED AS SUPPORTNG & COVERING MATERIAL



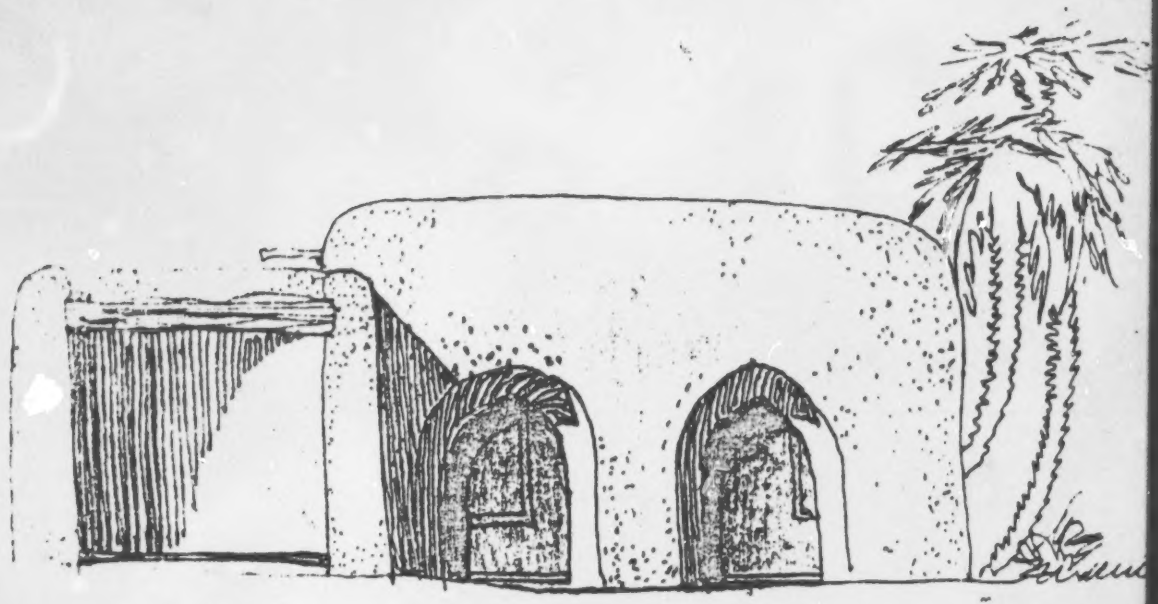
ELEVATION



SECTION

MUD PILE CONSTRUCTION

WOOD AS SPANNING & MUD AS SUPPORTING & COVERING MATERIAL



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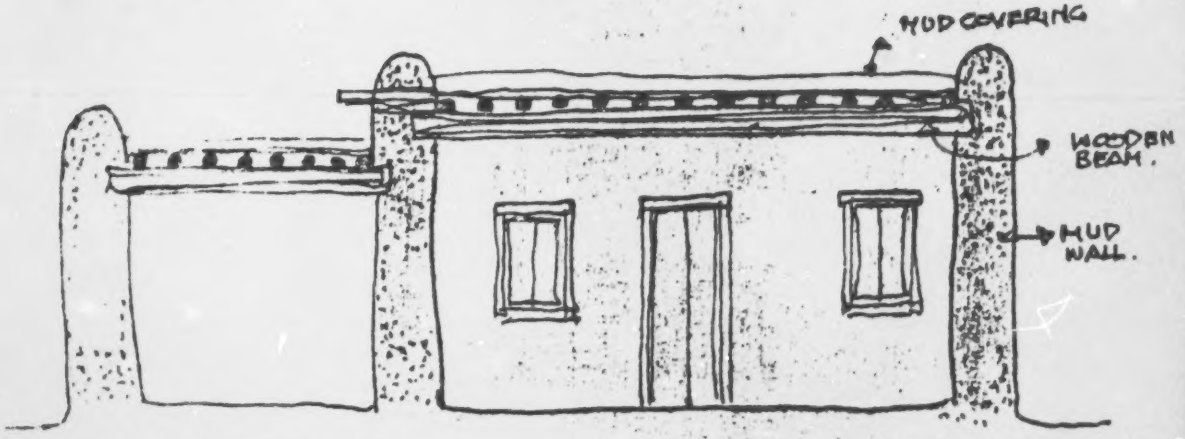
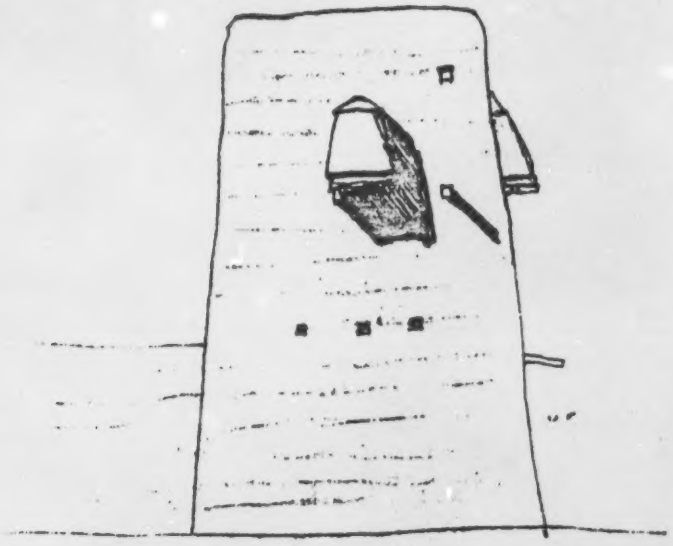


SECTION

MUD PILE CONSTRUCTION

WOOD AS SPANNING MATERIAL &
MUD AS SUPPORTING & COVERING MATERIAL.



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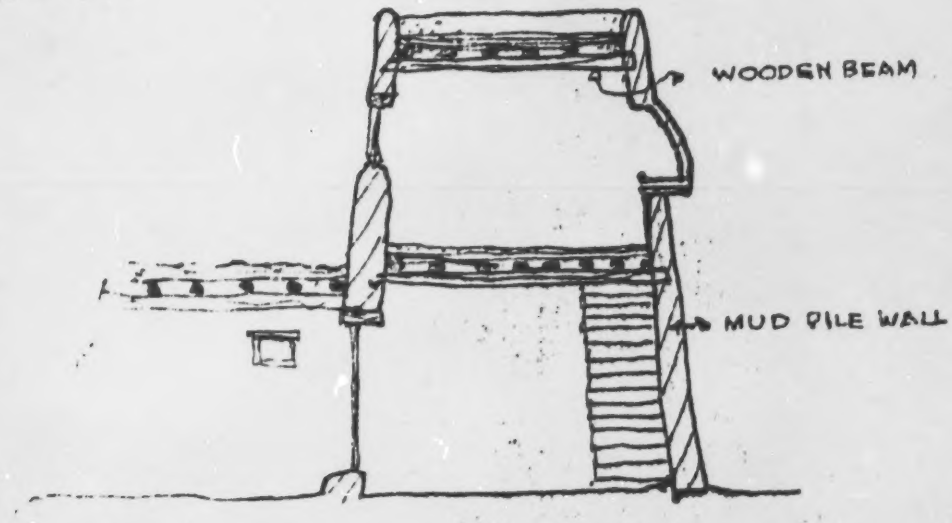
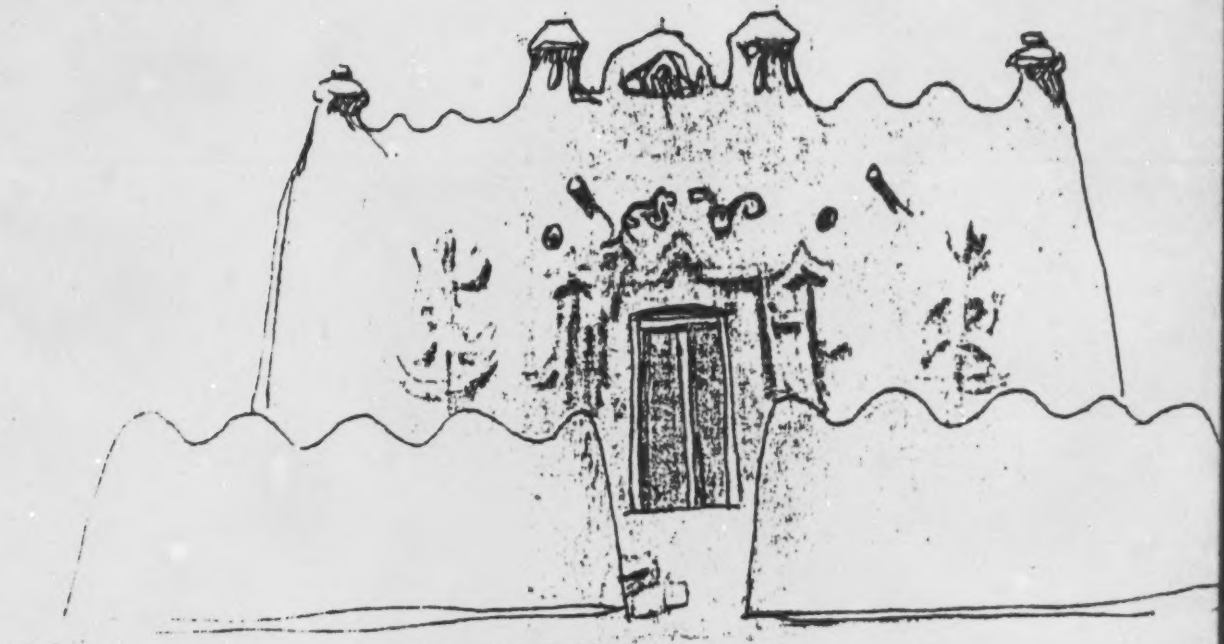


SECTION

MUD. PILE CONSTRUCTION

WOOD AS SPANNING MATERIAL
MUD AS SUPPORTING & COVERING MATERIAL.

D-9



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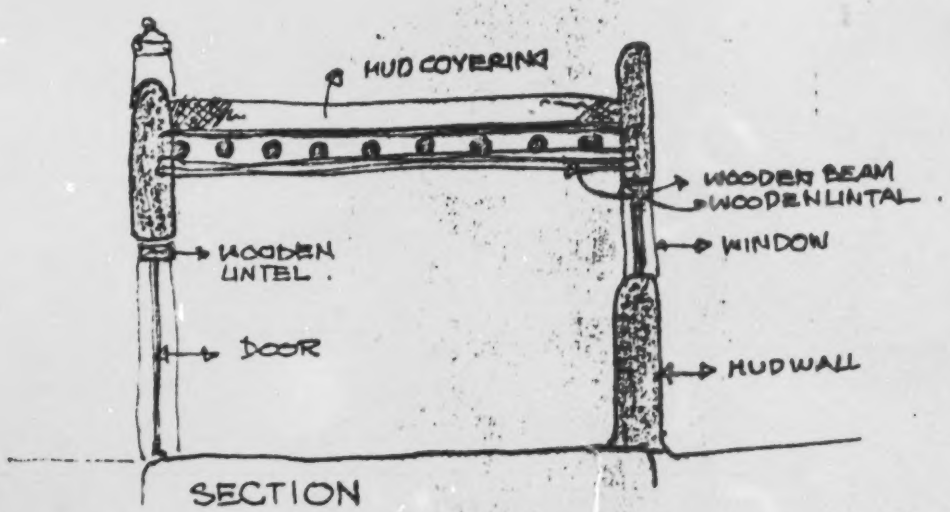
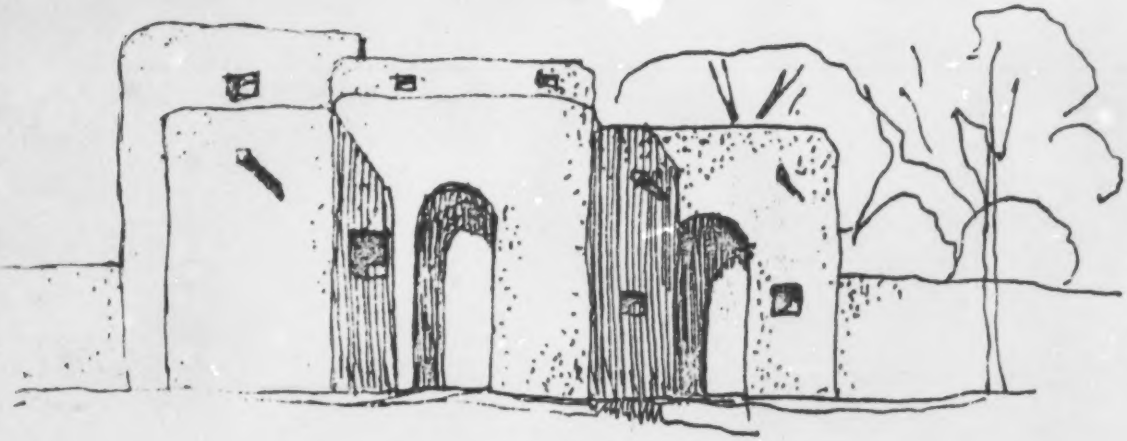


SECTION

MUD. PILE CONSTRUCTION

WOOD AS SPANNING MATERIAL & MUD AS SUPPORTING & COVERING MATERIAL.

D-10



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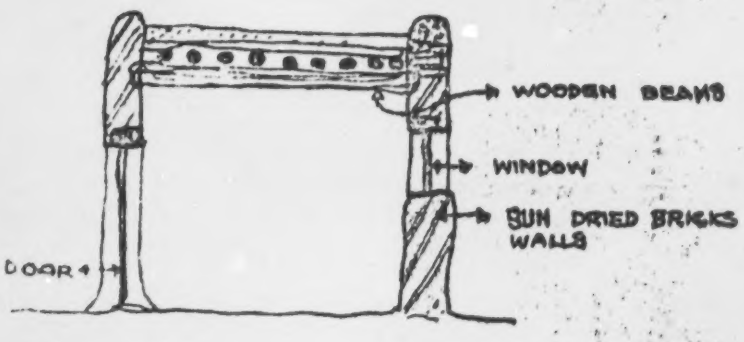
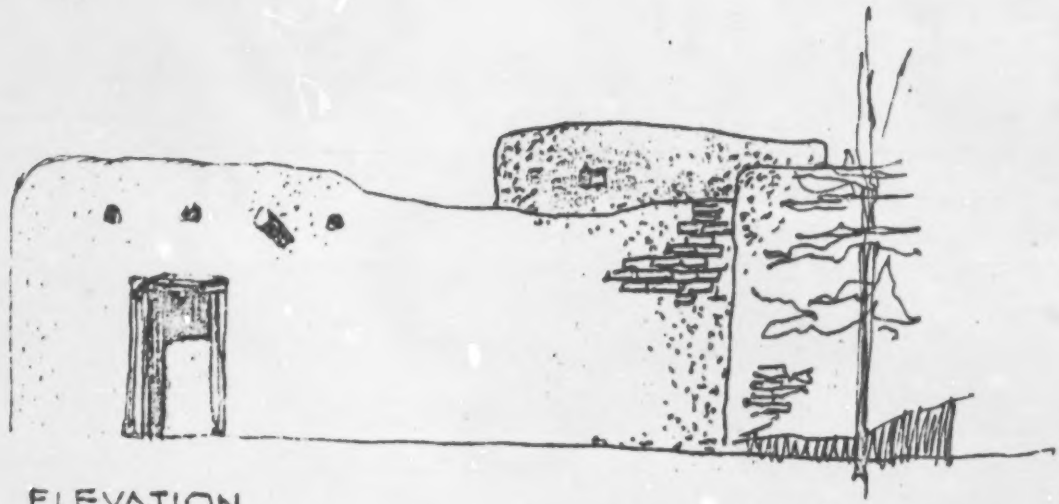


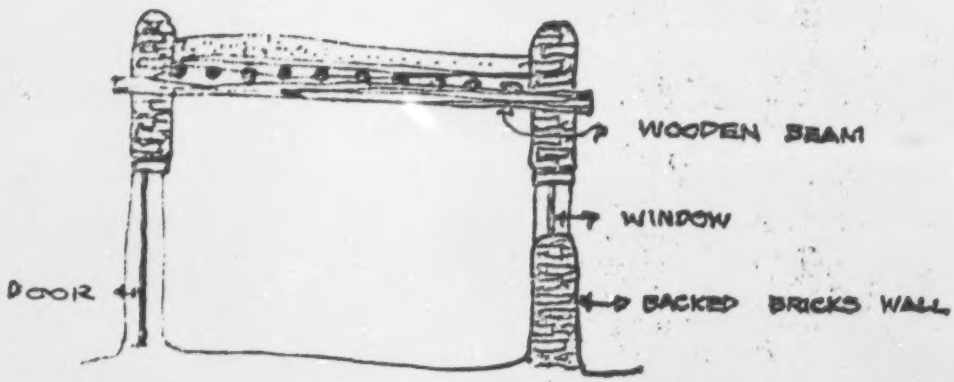
SECTION

SUN DRIED BRICK CONSTRUCTION

WOOD AS SPANNING MATERIAL
SUNDRIED BRICKS AS SUPPORTING MATERIAL



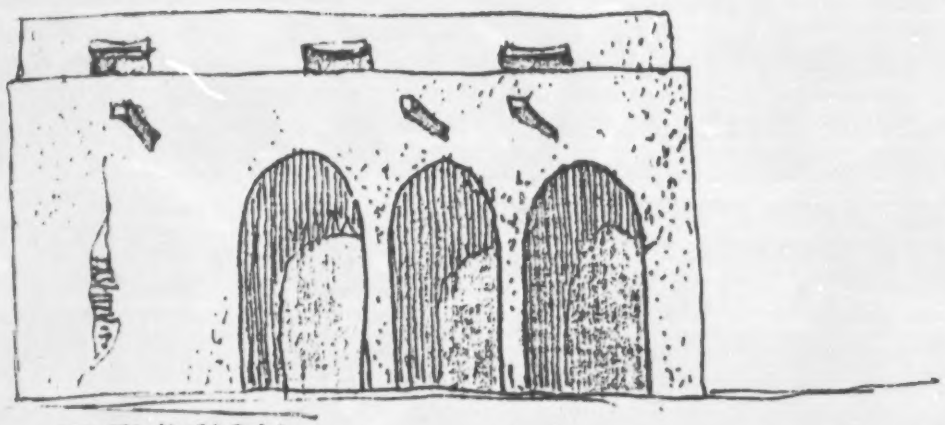
ELEVATION



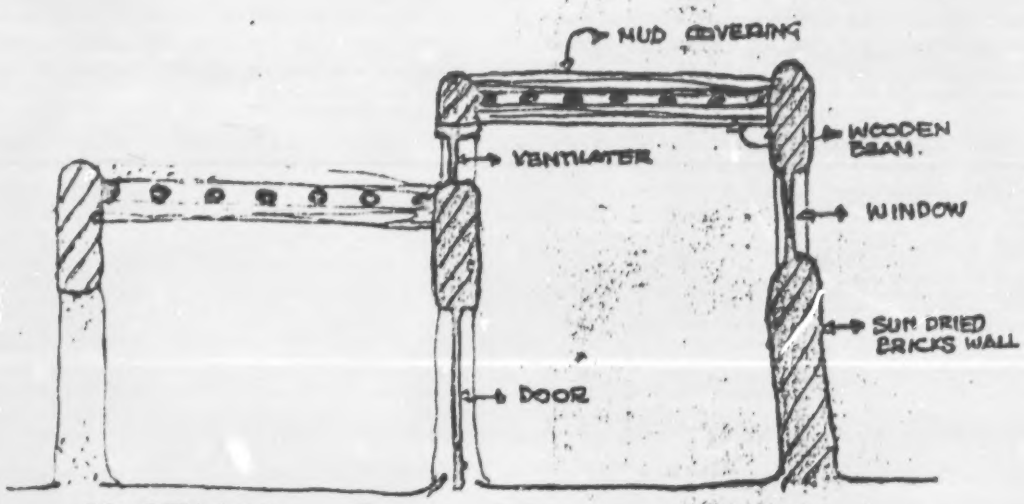
SECTION

SUN. DRIED BRICKS CONSTRUCTION

WOOD AS SPANNING MATERIAL & BACKED
BRICKS AS SUPPORTING MATERIAL



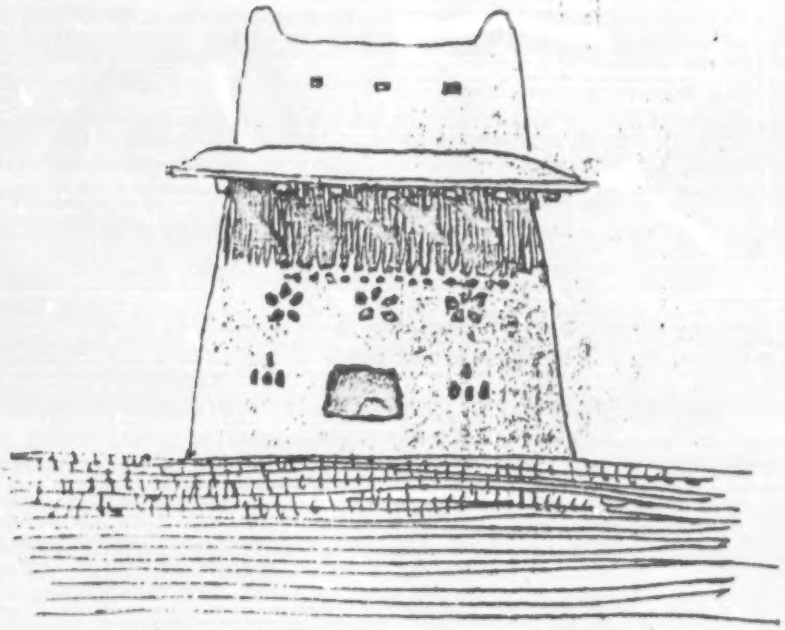
ELEVATION



SECTION

SUN DRIED BRICKS CONSTRUCTION

WOOD AS SPANNING MATERIAL & SUN DRIED BRICKS AS SUPPORTING & MUD AS COVERING MATERIAL.



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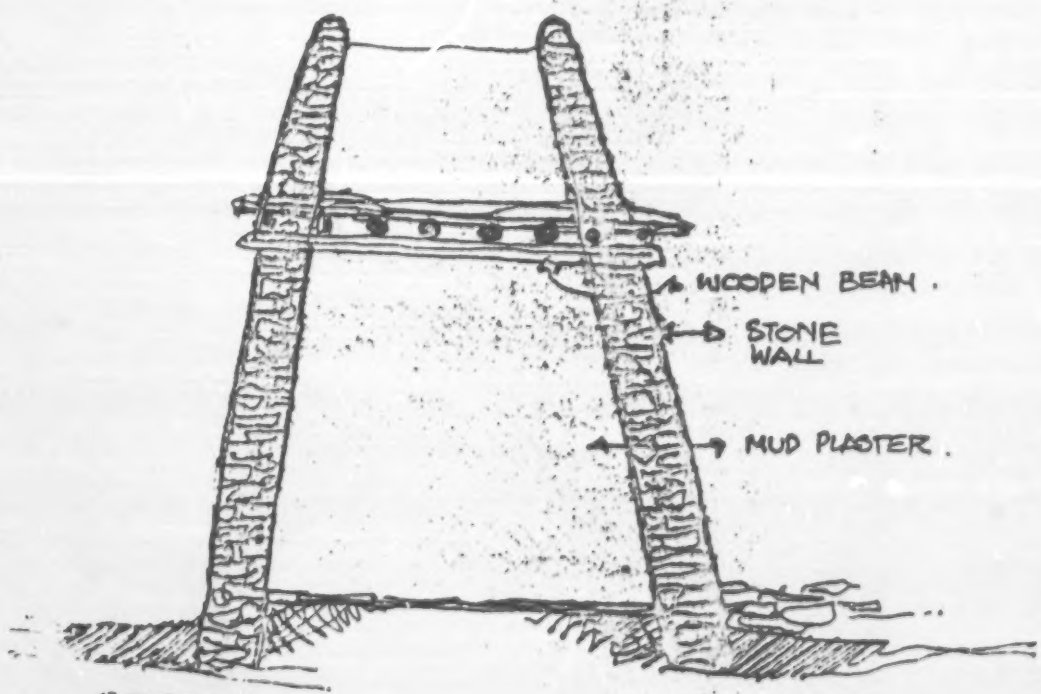
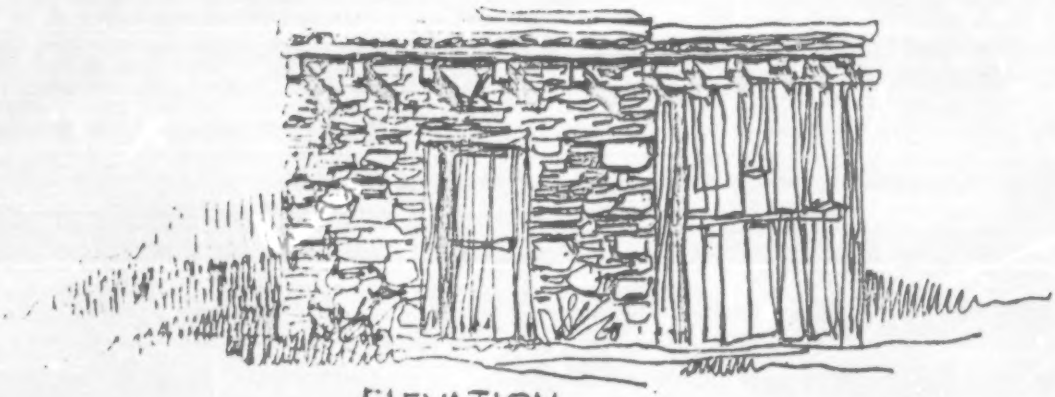


SECTION

MUD. STONE CONSTRUCTION

WOOD AS SPANNING MATERIAL & STONE AS SUPPORTING & MUD AS COVERING MATERIAL

D-14



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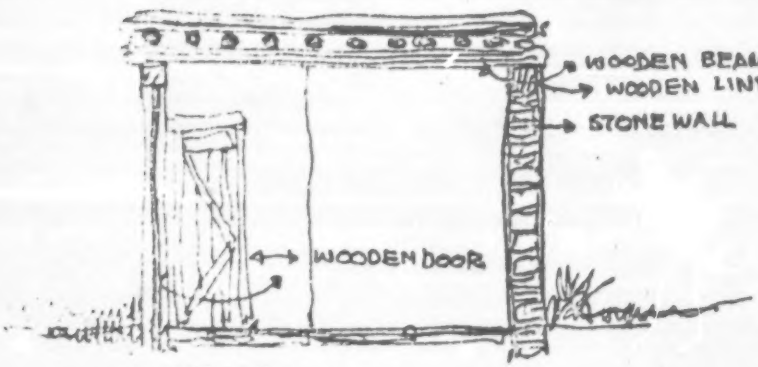
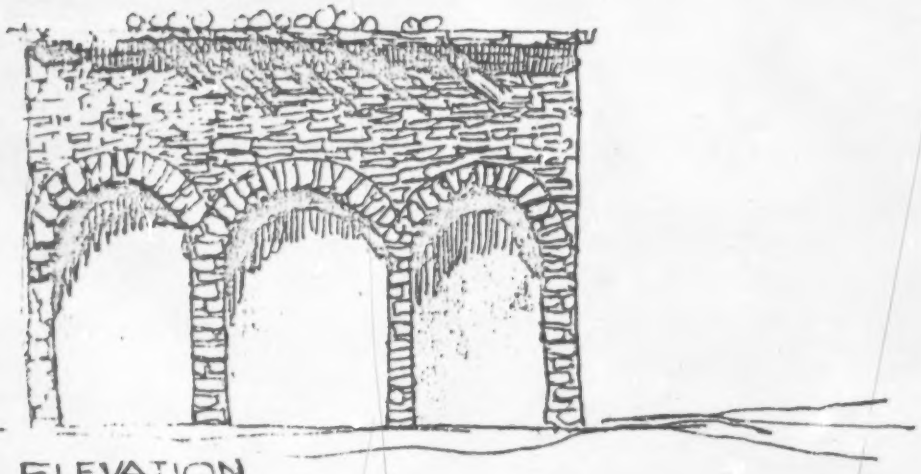


SECTION

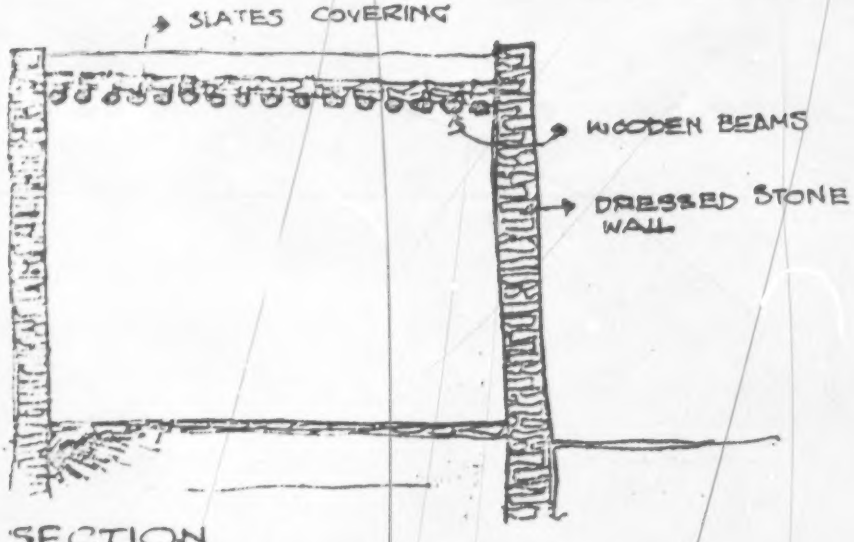
STONE WOOD CONSTRUCTION

WOOD AS SPANNING AS WELL AS SUPPORTING & COVERING MATERIAL, STONE AS SUPPORTING & COVERING MATERIAL.

D-15



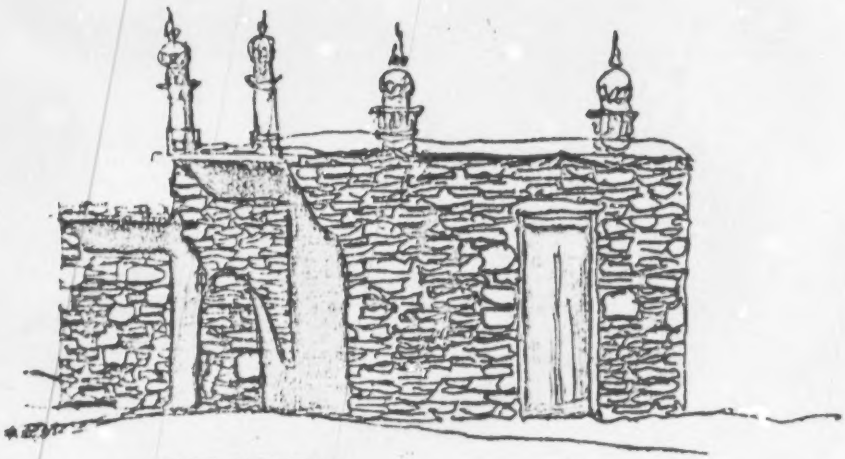
ELEVATION



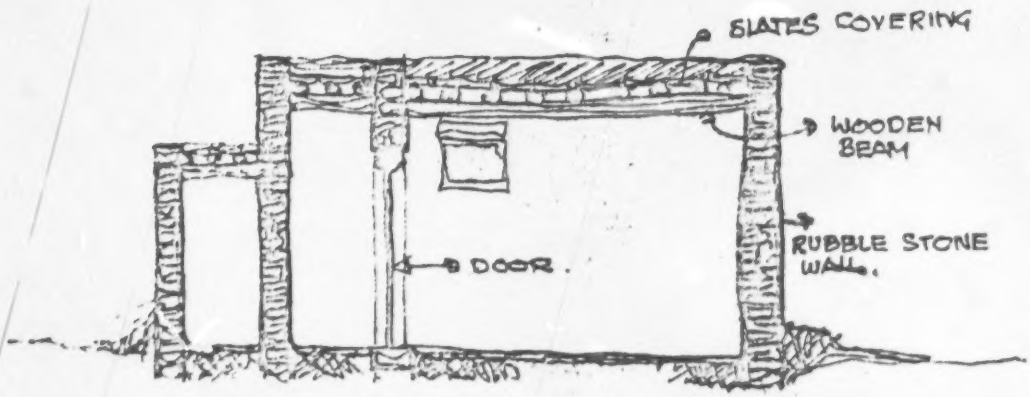
SECTION

DRESSED STONE CONSTRUCTION

STOE AS SUPPORTING & COVERING MATERIAL
WOOD AS SPANNING MATERIAL.



ELEVATION

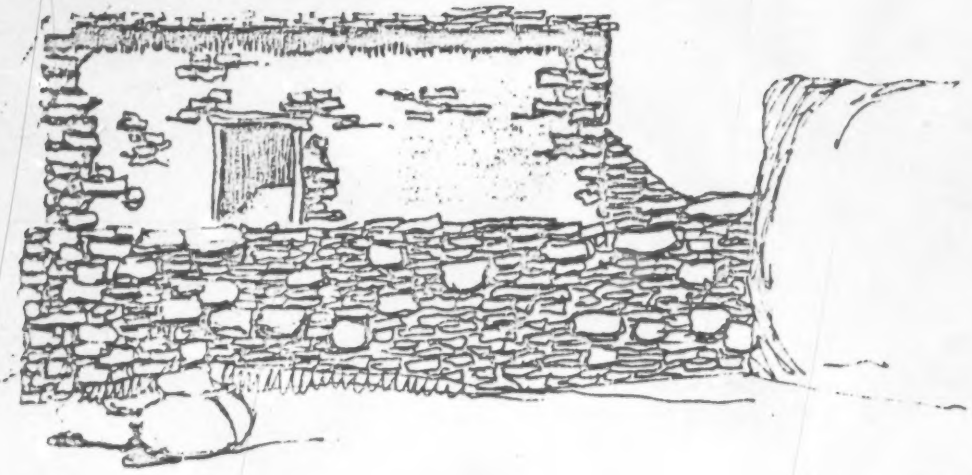


SECTION

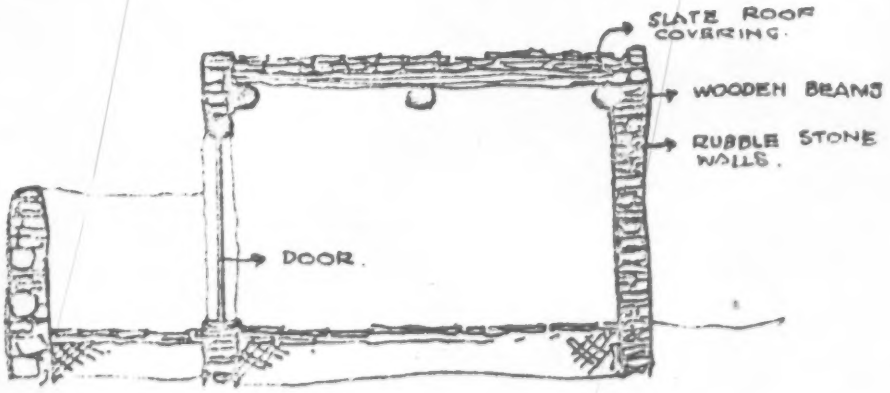
RUBBLE STONE CONSTRUCTION

WOOD AS SPANNING & STONE AS SUPPORTING & COVERING MATERIAL.

D-17



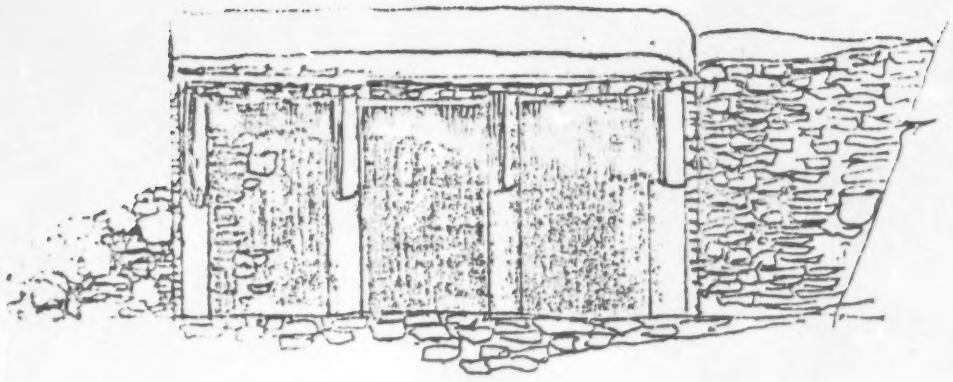
ELEVATION



SECTION

RUBBLE STONE CONSTRUCTION

WOOD AS STRUCTURAL (SPANNING) MATERIAL
STONE AS SUPPORTING & COVERING MATERIAL.



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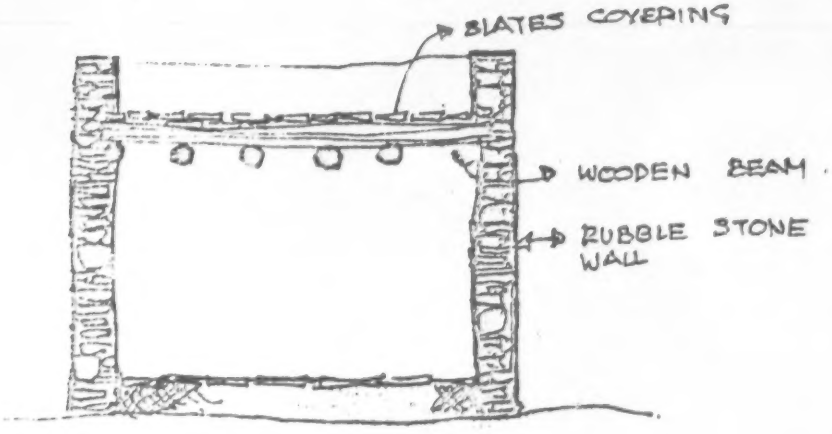


SECTION

RUBBLE STONE CONSTRUCTION

WOOD AS SPANNING MATERIAL. RUBBLE STONE AS SUPPORTING AND COVERING MATERIAL.

D-19

APPENDIX E

ARCHITECTURAL TREATMENT GUIDELINES FOR VARIOUS CLIMATIC CONDITIONS

ARCHITECTURAL TREATMENT FOR HOT DRY SEASON

RADIATION CONTROL:

Thick walls for insulation with minimum openings. Surface treatment to be planted both as grass and trees to avoid glare, direct and indirect radiation.

AIR TEMPERATURE:

Thick roofs and walls for insulation with minimum openings, vegetation to be planted both as grass hedges and trees, in front of the openings to filter the air there by increasing humidity and reducing air temperature.

AIR MOVEMENT:

Verticle barriers to be provided on the windward side in the form of walls and vegetation.

HUMIDITY:

It is to be increased by the presence of water and vegetation. This is done to reduce air temperature.

STORMS:

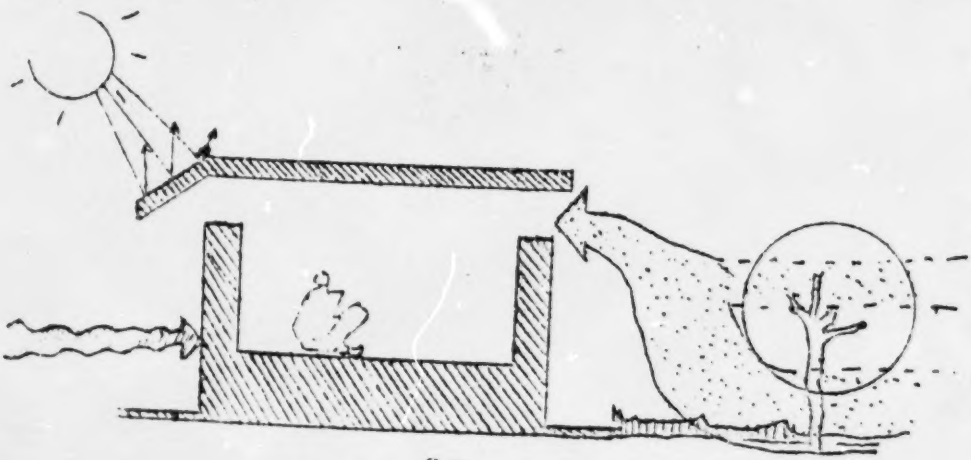
Small openings to avoid dust and sand storm.

PRECIPITATION:

Varies from climate to climate.

ANALYSIS:

Final building forms for hot dry season for any climatic type would be: Thick roofs and walls (for insulation purposes) Minimum openings (necessary for ventilation and light only) preferably on north and south side. Vegetation to be provided in front of the openings in the form of grass, hedges, trees etc.



RADIATION CONTROL:

Light and reflecting exterior roof surfaces and vegetation to be provided above the height of ten feet in the form of trees.

AIR TEMPERATURE

Negligible factor.

HUMIDITY:

The presence of water and vegetation is to be avoided and maximum air movement is to be provided.

AIR MOVEMENT:

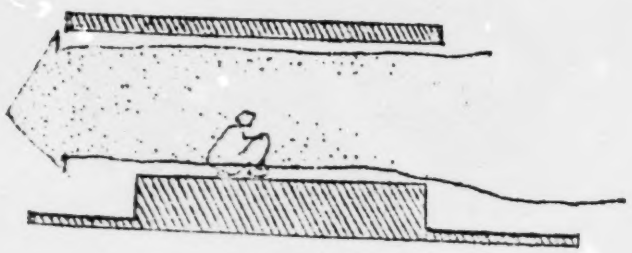
Maximum opening, thereby having minimum barriers such as walls and vegetation etc.

PRECIPITATION:

Varies from climate zone to climate zone.

ANALYSIS:

Light and reflecting roof surgaces maximum openings to be orientated towards the winward side (so as to cater for maximum air movement). Vegetation to be provided above 10 ft (so as to avoid radiation and to permit air movement.



ARCHITECTURAL TREATMENT FOR COLD SEASON

RADIATION CONTROL:

Maximum radiation is to be provided through roofs and walls (if possible). Vegetation to be avoided.

AIR TEMPERATURE:

Thick walls to store heat.

HUMIDITY:

Negligible factor

AIR MOVEMENT

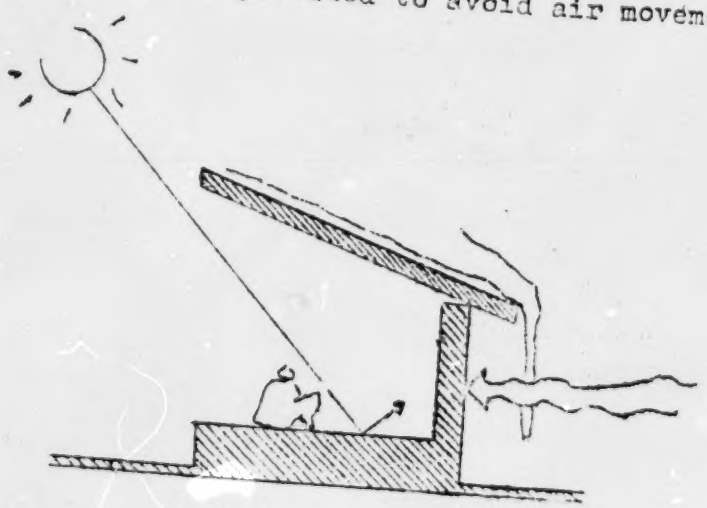
Physical barriers to be provided to stop the cold air movement.

PRECIPITATION:

Varies from climate zone to climate zone.

ANALYSIS:

Thick walls and roofs to be provided (to store heat), maximum openings to obtain solar radiation, physical barriers to be provided to avoid air movement.



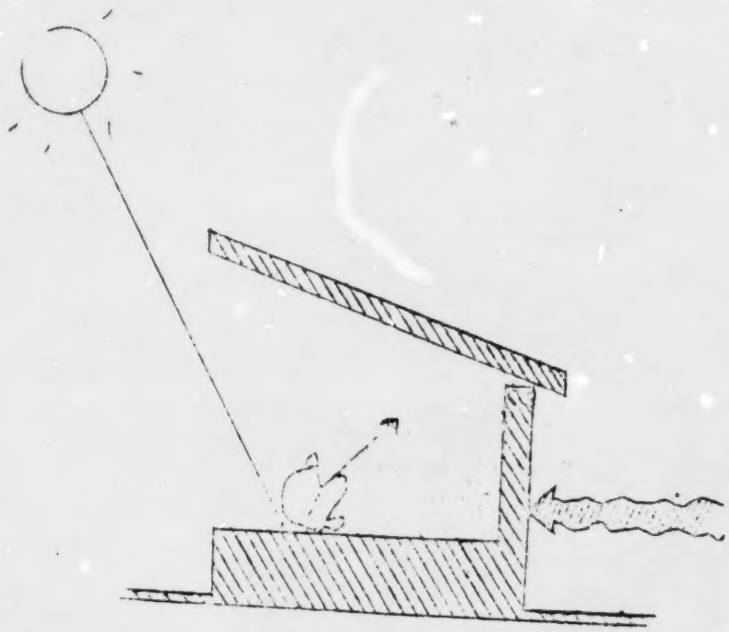
ARCHITECTURAL TREATMENT FOR COOL AND COLD COMPOSITE

DOMINATING SEASONS

Cold

CONTROLLING FACTORS

Thick walls and roof to provide the storage of heat, maximum openings to obtain solar radiation, physical barriers to be provided to avoid air movement. Heavy structures to cater for the snow fall.

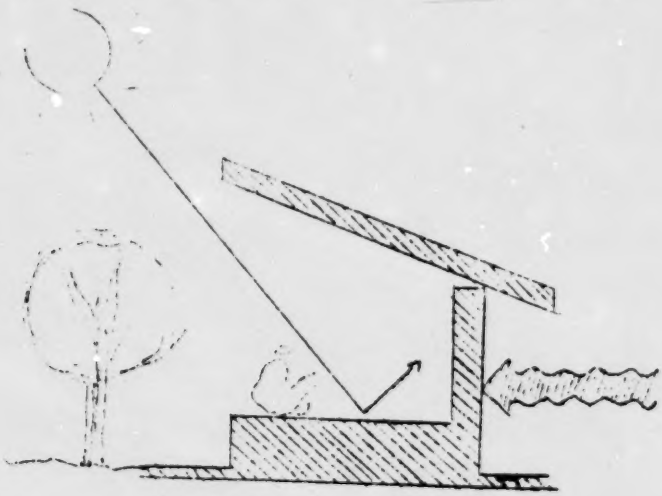


TREATMENT FOR EXTRA DRY COOL

TREATMENT FOR ALL SEASONS.

CONTROLLING FACTORS

THICK WALLS and roofs to be provided (to store heat, maximum openings to obtain solar radiation, physical Barriers to be provided to avoid air movement. Heavy structures to cater for the snow fall.



Dominating Seasons

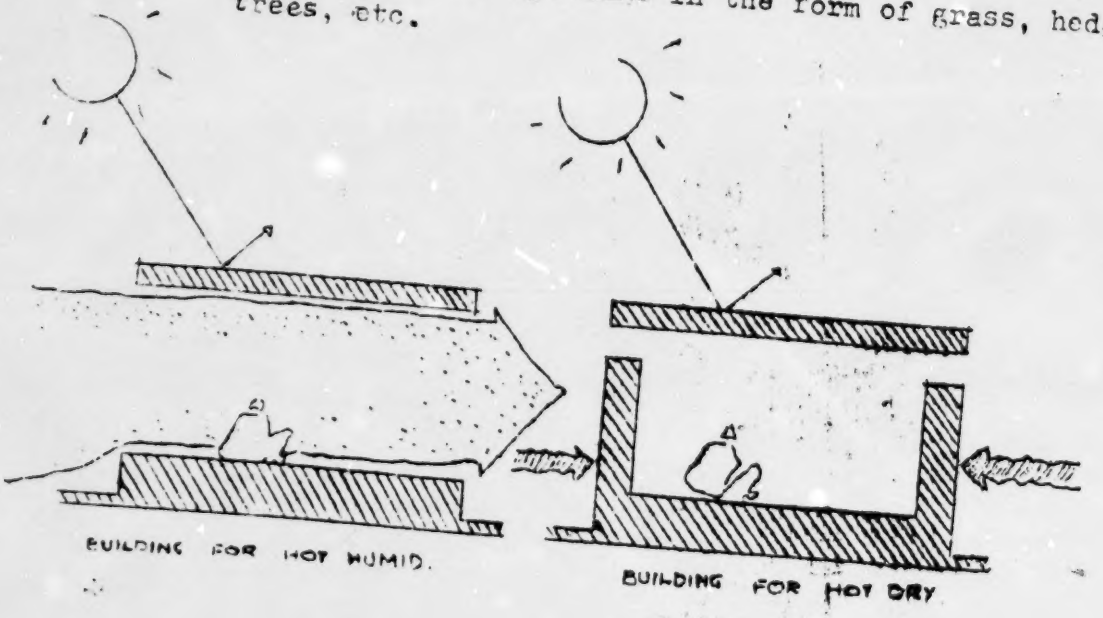
Hot dry and hot humid. This necessitates two seperate buildings to cater for this climatic type.

HOT HUMID

Light and reflecting roof surfaces with maximum openings to be orientated towards the windward side (so as to cater for maximum air movement). Vegetation to be provided above 10ft (so as to avoid radiation and to permit air movement). Heavy rainfall going upto 30 inches/year.

HOT DRY:

Thick roof and walls for insulation purposes minimum openings (necessary for ventilation and light only) preferably on north and south side. Vegetation to be provided in front of the openings in the form of grass, hedges, trees, etc.



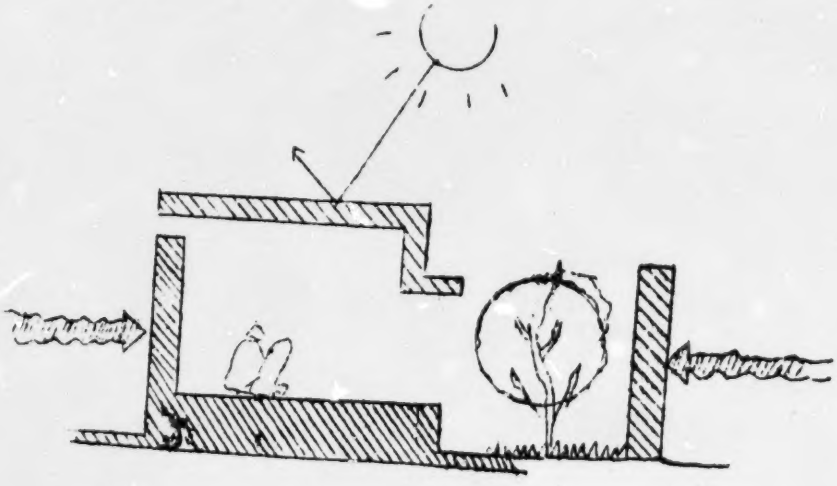
PROVISIONS FOR EXTRA DRY HOT

DOMINATING SEASON

Hot dry.

CONTROLLING FACTORS

Thick roofs and walls (for insulation purposes) minimum openings (necessary for ventilation and light only) preferable orientation on north and south side. Vegetation to be provided in front of the openings in the form of grass hedges trees etc. Precipitation rare. Small openings to be provided so as to prevent the effect of storms.

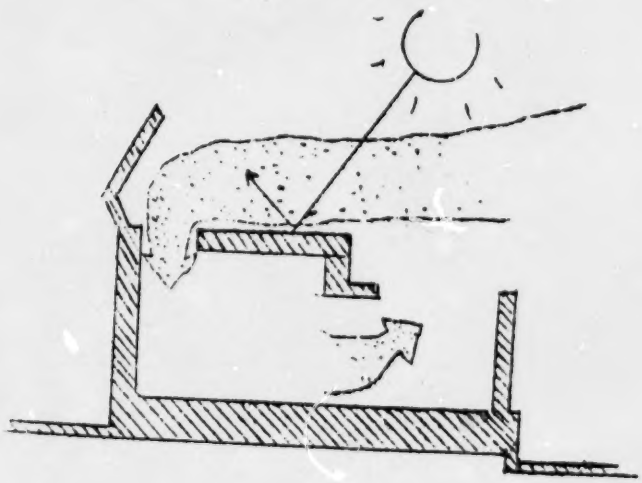


DOMINATING SEASONS

Hot dry and hot humid.
as in this climatic type both seasons act simultaneously i.e. prevailing winds carry moisture brought in from the sea but basically it is an hot dry region.

CONTROLLING FACTORS

Thick roofs and walls (for insulation purposes) minimum openings (necessary only for ventilation and light only), preferable orientation on north and south. Vegetation to be provided to reduce radiation effect. Main feature of the Inland maritime is that wind catchers are to be provided so as to permit air mivement and to prevent radiation (as shown in the sketch below).

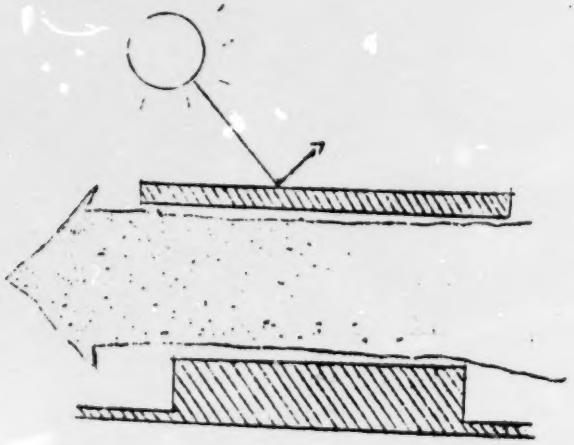


DOMINATING SEASONS

Hot humid.

CONTROLLING FACTORS

Light and reflecting roof surface, maximum openings and to be orientated towards the winward side. Building to be placed at an elevation so as to provide maximum air movement. Vegetation to be provided above 10 ft (so as to avoid radiation and to permit air movement. Precipitation is negligible.



SUMMARY OF ARCHITECTURAL TREATMENT REQUIRED IN EACH CLIMATIC ZONE

		RECOMMENDATIONS
MARITIME	Topography:	
	Land form.....	Elevated
	Bodies of water.....	Prevented
	Vegetation.....	Above body level
	Window orientation.....	North & south preferably
	Air movement.....	Winward oriented.
INLAND MARITIME	Topography:	
	Land form.....	Elevated
	Bodies of water.....	Required
	Vegetation.....	At & above body level
	Window orientation.....	North and south
	Air movement.....	Required
EXTRA DRY HOT	Topography:	
	Land form.....	--
	Bodies of water.....	Preferable
	Vegetation.....	Required at and above body level
	Window orientation.....	North & South
	Air movement.....	Prevented
EXTRA DRY COOL	Topography:	
	Land form.....	South end of the hill or mountain
	Bodies of water.....	Preferable
	Vegetation.....	Only to increase Humidity
	Window orientation.....	South and East
	Air movement.....	Prevented
COOL COMPOSITE COLD COMPOSITE	Topography:	
	Land form.....	South end of hill or Mount.
	Bodies of water.....	Negligible factor
	Vegetation.....	To be prevented
	Window orientation.....	South and East
	Air movement.....	Prevented
WARM COMPOSITE Humid Period	Topography:	
	Land form.....	Elevated
	Bodies of water.....	Prevented
	Vegetation.....	Above body level
	Window orientation.....	North and South prefered.
	Air movement.....	Required. Prevent barrier.

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WARM COMPOSITE Hot Dry Period	Topography:	
	Land form.....	--
	Bodies of water.....	Preferable
	Vegetation.....	At and above body level
	Window orientation.....	North and south
	Air movement.....	To be prevented by barriers or filtered through vegetation.
NORMAL COMPOSITE Humid Period	Topography:	
	Land form.....	Elevated
	Bodies of water.....	Prevented
	Vegetation.....	Above body level
	Window orientation.....	North & South preferable
	Air movement.....	Required.Prevent barrier
NORMAL COMPOSITE Hot Period	Topography:	
	Land form.....	---
	Bodies of water.....	Required
	Vegetation.....	At & above body level
	Window orientation.....	North & South preferable
	Air movement.....	To be prevented by barriers or filtered through vegetation
NORMAL COMPOSITE Cold Period	Topography:	
	Land form.....	Negligible
	Bodies of Water.....	Negligible
	Vegetation.....	Prevented
	Window orientation.....	South and West
	Air movement.....	Prevented

A P P E N D I X F

DESIGN TEAM OF "SCHOOLS FOR PAKISTAN"

AND THEIR ACKNOWLEDGEMENTS

DESIGN FORM OF APPENDIX SCHOOLS FOR PAKISTAN.

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